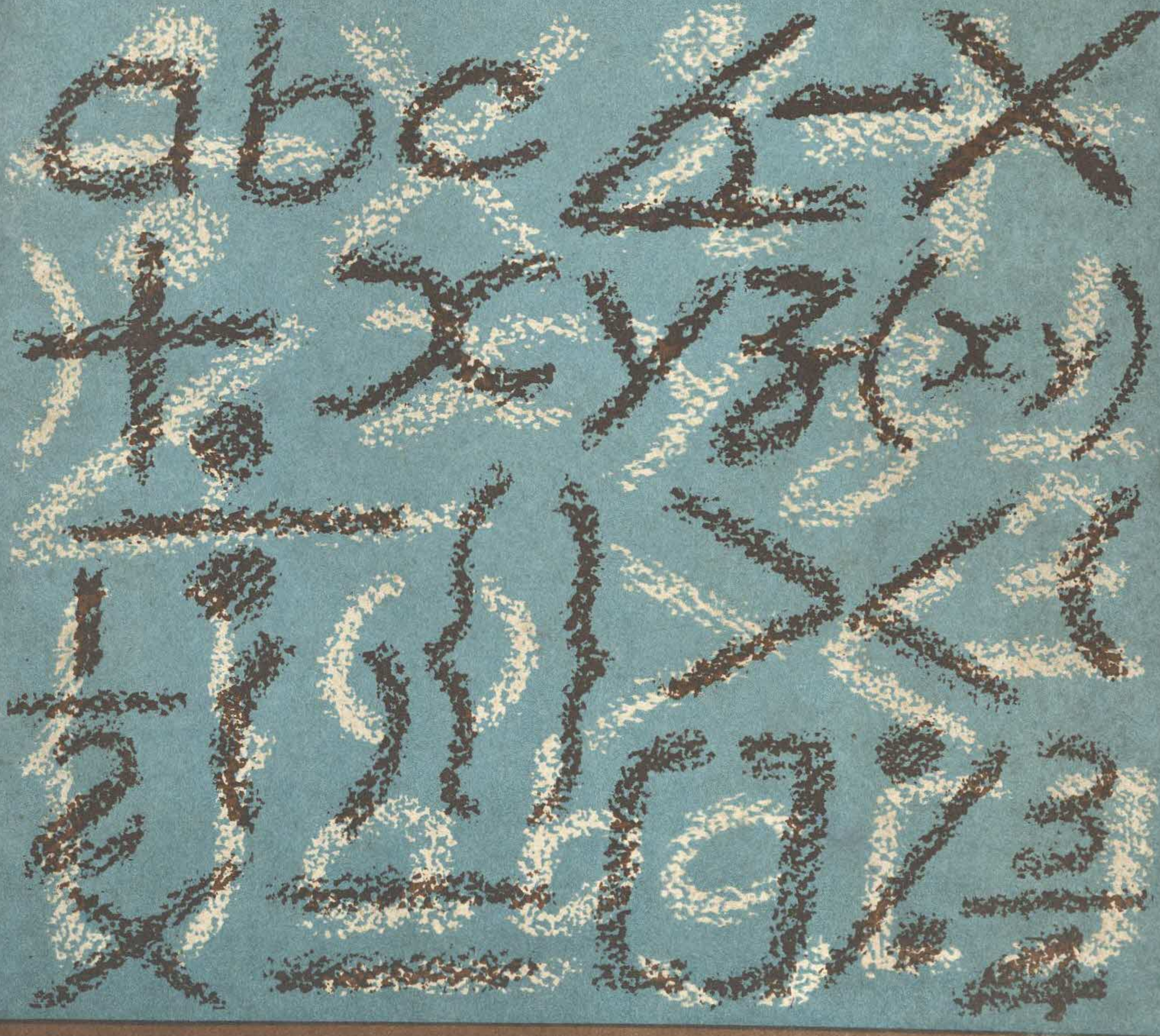
MATHEMATICS

581

FOR PRIMARY SCHOOLS

BOOK V



306

MATHEMATICS

FOR PRIMARY SCHOOLS

BOOK V

R.C. Saxena
Ishwar Chandra
S.K. Singh Gautam

S.C.E.R.T., West Bengal
Library
Calcutta
25/3, B. C. Road

विद्ययाऽमृतमश्नुते

एन सी ई आर टी
NCERT

राष्ट्रीय शैक्षिक अनुसंधान और प्रशिक्षण परिषद्
NATIONAL COUNCIL OF EDUCATIONAL RESEARCH AND TRAINING

May 1983
Vaisakha 1905

P.D. 100 T—YL

© *National Council of Educational Research and Training, 1983*

S.C.E.R.T., West Bengal
Date....12/12/84
Acc. No....3067....

Rs. 9.65

PUBLISHED AT THE PUBLICATION DEPARTMENT BY C. RAMACHANDRAN, SECRETARY, NATIONAL COUNCIL OF EDUCATIONAL RESEARCH AND TRAINING, SRI AUROBINDO MARG, NEW DELHI 110016 AND PRINTED AT ALLIED PUBLISHERS PVT. LTD. 104-MAYAPURI, PHASE II, NEW DELHI 110064

FOREWORD

The primary stage is the most crucial one for the education of a child. In the learning of mathematics it assumes added significance. It is at this stage that children are exposed to some of the most fundamental notions, namely, numbers, operations, measurements and spatial relationships, and are expected to acquire proficiency in using mathematics in everyday life.

This book is the fifth in the series entitled **'Mathematics for Primary Schools'** which has been developed by the Department of Education in Science and Mathematics, National Council of Educational Research and Training, for the students of primary classes in India. This book, like the first four in the series, aims at the development of insightful learning. As such there is greater emphasis on the understanding of principles and processes, and development of the structure of mathematical operations and concepts. Systematic development of the number system, awareness of key ideas and their relationships, development of the power of thinking and reasoning and use of mathematical language have also been emphasised. For obvious reasons, set theory is not explicitly used in the book, but is implicitly involved in the discussions of mathematical concepts. The book provides for wider applications of mathematics in the home and in business, industry, measurement, etc. To satisfy the needs of fast learners, some concepts and problems have been star-marked.

The overall coordination for the development of this book was done by Shri R.C. Saxena of the Department of Education in Science and Mathematics. The detailed planning of the text was done by Shri Ishwar Chandra of the same Department. The first draft was developed by Shri R.C. Saxena, Shri Ishwar Chandra and Dr. S.K.S. Gautam, all of the Department of Education in Science and Mathematics. A preliminary review of the draft materials was made in a workshop held at Regional College of Education, Ajmer, in August 1981. The final draft was again reviewed in a workshop held at Atomic Energy Central School, Anushakti Nagar, Bombay, in March 1982. In both the review workshops, practising teachers, subject experts and teacher educators were involved. In the light of their suggestions, the materials were further edited by the team of authors. In this exercise valuable suggestions were given by Shri G.D. Dhall and Shri Mahendra Shanker, both of the Department of Education in Science and Mathematics.

I am grateful to all the participants of the two workshops and to all my colleagues in the Department of Education in Science and Mathematics for the work that they have done.

The Council will be grateful to the users of this book for suggestions which will help us to make further improvement in the book.

T.N. Dhar
Joint Director
National Council of Educational
Research and Training

New Delhi
January 1983

ACKNOWLEDGEMENTS

The National Council of Educational Research and Training is grateful to the following who reviewed the first draft of this textbook in a workshop held for this purpose at Regional College of Education, Ajmer (Rajasthan), from 10 August 1981 to 14 August 1981.

1. Shri O.P. Agrawal
   Mayo College
   Ajmer
2. Shri K.L. Arya
   Regional College of Education
   Ajmer
3. Shri R.M. Bhagwat
   Homi Bhabha Centre for
   Science Education
   T.I.F.R.
   Bombay
4. Shri Ishwar Chandra
   National Council of Educational
   Research and Training
   New Delhi
5. Shri C.P.S. Chauhan
   Banaras Hindu University
   Varanasi
6. Dr. S.K. Singh Gautam
   National Council of Educational
   Research and Training
   New Delhi
7. Shri S.L. Jain
   Govt. Teacher's College
   Ajmer
8. Shri S.P. Nigam
   Retd. Head of the Mathematics Department
   D.A.V. College, Kanpur
   Uttar Pradesh
9. Shri K.S. Pandey
   Vidya Bhawan Higher Secondary School
   Udaipur
10. Shri Chinu Bhai P. Patel
    P.B.P. Jain High School
    Kalupur, Tanksal
    Ahmedabad
11. Shri S.N. Rai
    Govt., Central Pedagogical Institute
    Allahabad
12. Miss E. Roopa Rao
    Kamla Baliga College of Education, Kumta
    Karnataka
13. Miss Poonam Sachdev
    Our Lady of Fatima Convent High School
    Gurgaon
    Haryana
14. Shri R.C. Saxena
    National Council of Educational
    Research and Training
    New Delhi
15. Mrs. H.P. Shamla
    Demonstration Multipurpose School
    Regional College of Education
    Mysore

The Council is also grateful to the following who reviewed the final draft of this textbook in a workshop held for this purpose at Atomic Energy Central School, Anushakti Nagar, Bombay, from 26 March 1982 to 31 March 1982.

1. Smt. Shobha Bose
   Atomic Energy Central School No. 2
   Bombay
2. Mrs. Rashmi Chandorkar
   Demonstration Multipurpose School
   Regional College of Education
   Bhopal
3. Shri Ishwar Chandra
   National Council of Educational
   Research and Training
   New Delhi
4. Smt. Sarada Chandrasekharan
   Kendriya Vidyalaya No. 2
   Colaba, Bombay
5. Miss Esmie D'coutho
   Atomic Energy Central School
   Tarapur
   Bombay
6. Dr. S.K. Singh Gautam
   National Council of Educational
   Research and Training
   New Delhi
7. Mrs. V. George
   Kendriya Vidyalaya No. 3
   Sassoon Dock, Colaba
   Bombay
8. Shri B.M. Gupta
   Board of Secondary Education
   Allahabad
9. Smt. Yogini B. Hajisheth
   Navarachana Higher Secondary School
   Baroda
10. Mrs. Mayura Iyengar
    New Era High School
    Panchgani, Satara
    Maharashtra
11. Mrs. Usha R. Kerur
    Kendriya Vidyalaya No. 3
    Colaba, Bombay
12. Smt. Savitri Keswani
    Demonstration Multipurpose School
    Regional College of Education
    Ajmer
13. Dr. D.B. Muley
    Institute of Science
    Aurangabad
    Maharashtra
14. Shri M.Muralidhar
    Kendriya Vidyalaya No. 1
    Navy Nagar, Colaba
    Bombay
15. Mrs. Karpugvalli Naicker
    Pre-Primary Training Institute
    Jabalpur
16. Miss Sudha Nautiyal
    Kendriya Vidyalaya No. 1
    Navy Nagar, Colaba
    Bombay
17. Shri K.S. Pandey
    Vidya Bhawan Hr. Sec. School
    Udaipur
18. Shri Pradip B. Pandya
    Shreyas Vidyalaya (E.M.)
    Manjalpur Naka
    Baroda
19. Mrs. Padmaja Panicker
    Kendriya Vidyalaya
    I.I.T. Powai
    Bombay
20. Mrs. Visweswari Prasad
    Atomic Energy Central School No. 1
    Bombay
21. Shri T. Punnaiah
    Atomic Energy Central School
    ECIL (P.O.) Hyderabad
22. Shri S.N. Rai
    Govt. Central Pedagogical Institute
    Allahabad

23. Shri G. Hanumantha Rao
St. Theresa's High School
Ongole, Prakasam (Distt.)
Andhra Pradesh

24. Mrs. S. Ramanathan
St. Xavier's Higher Secondary School
Palayamkottai, Tirunelveli-2
Tamil Nadu

25. Mrs. Malathi Ramnath
Kendriya Vidyalaya
I.I.T. Powai
Bombay

26. Smt. Rukmini Rangarajan
Atomic Energy Central School
Anushakti Nagar
Bombay

27. Shri R.C. Saxena
National Council of Educational
Research and Training
New Delhi

28. Shri V. Seshan
Atomic Energy Central School
Anushakti Nagar
Bombay

29. Mrs. A.K. Sequeira
Atomic Energy Central School
Anushakti Nagar
Bombay

30. Shri G.P. Srivastava
Pt. L.S. Jha Hr. Sec. School
Jabalpur

31. Mrs. Meena Srivastava
Pitts Modern School
Gomia, Bihar

32. Dr. N.N. Srivastava
State Institute of Science Education
Jabalpur

33. Shri S.P. Srivastava
Govt. Inter College
Faizabad
Uttar Pradesh

34. Mrs. P. Theophilus
Kendriya Vidyalaya
INS Hamla
Bombay

35. Smt. V.V.P. Tulasi
Atomic Energy Secondary School
Bombay

36. Mrs. Annie Verghese
Kendriya Vidyalaya No. 2
N.T. Pool, Colaba
Bombay

CONTENTS

Page

Foreword (iii)

Acknowledgements (iv)

Units

I REVIEW OF THE WORK DONE IN EARLIER CLASSES 1

II. WHOLE NUMBERS 6

2.1 Reading and Writing of Numbers 6
2.2 Ordering of Numbers 9
2.3 Operations and Properties 10
*2.4 Roman System of Numeration 11
*2.5 The Binary or Base-2 Numeration System 14

III. FACTORS AND MULTIPLES 18

3.1 Some Properties of Divisibility 18
3.2 Divisibility by 4 and 8 19
3.3 Division Method of Finding H.C.F. 21
3.4 Division Method of Finding L.C.M. 25
3.5 The Product of H.C.F. and L.C.M. of Two Numbers 26
3.6 Everyday Problems on H.C.F. and L.C.M. 27

IV. FRACTIONAL NUMBERS 30

4.1 Multiplication of a Fractional Number by a Whole Number 30
4.2 Multiplication of a Fractional Number by a Fractional Number 30
4.3 Multiplication of Fractions and Mixed Numbers 31
4.4 Multiplication of More Than Two Fractional Numbers 32
4.5 Simplification of Fractions 32
4.6 Properties of Multiplication of Fractional Numbers 33
4.7 Reciprocal of a Fractional Number 38
4.8 Division of a Fractional Number by a Whole Number 39
4.9 Division of a Fractional Number by a Fractional Number 40
4.10 Properties of Division of Fractional Numbers 42
4.11 Simplifications of Expressions Involving Fractional Numbers 43
4.12 Everyday Life Problems Involving Multiplication and Division of Fractional Numbers 45

V. DECIMALS 48

5.1 Review 48
5.2 To Convert Decimals into Common Fractions 50
5.3 To Convert Common Fractions into Decimals 51
5.4 Multiplication of a Decimal by a Natural Number 54
5.5 Multiplication of a Decimal by 10, 100, 1000, etc. 55
5.6 Multiplication of a Decimal by a Decimal 56
5.7 Division of a Decimal by a Natural Number 58
5.8 Division of a Decimal by a Decimal 61
5.9 Division of a Decimal by 10, 100, 1000, etc. 62
5.10 Everyday Life Problems Involving Decimals 64

VI. ORDER OF OPERATIONS AND GROUPING SYMBOLS 67

6.1 Order of Operations 67
6.2 Use of Grouping Symbols 68

VII. LINES AND ANGLES 72

7.1 Review 72
7.2 Pairs of Angles 73
7.3 Bisector of an Angle 77
7.4 Perpendicular Bisector of a Line-segment 78
7.5 Parallel Lines 78

VIII. TRIANGLES, QUADRILATERALS AND CIRCLES 82

8.1 Triangles 82
8.2 Kinds of Triangles 82
8.3 Properties of Triangles 83
8.4 Sum of the Angles of a Triangle 83
8.5 Construction of Triangles 85
8.6 Quadrilaterals 88
8.7 Circles 93

IX. MENSURATION 97

9.1 Review 97
9.2 Area of the Four Walls of a Room 98
9.3 Area of Paths 101
9.4 Measurement of Solids—Concept of Volume 103
9.5 Building Cuboids and Cubes with the Help of Unit Cubes 104

X. PER CENTS 108

10.1 Meaning of Per Cent 108
10.2 To Convert Common Fractions into Per Cents 110
10.3 To Convert Per Cents into Common Fractions 111
10.4 To Convert Decimals into Per Cents 111
10.5 To Convert Per Cents into Decimals 112
10.6 Money and Metric Measures as Per Cents 113

10.7 To Find the Value of a Given Per Cent of a Given Quantity 114
10.8 To Find the Quantity When a Given Per Cent of It Is Known 114
10.9 To Find What Per Cent One Number Is of Another 115
10.10 Applications of Per Cent 116
I. General Situations 116
II. Profit and Loss 118
III. Simple Interest 122

XI. RATIO, PROPORTION AND VARIATION 127

11.1 Ratio as a Form of Comparison 127
11.2 Proportion 131
11.3 Direct Variation 135
11.4 Inverse Variation 137
11.5 Unitary Method 138

XII. BAR GRAPHS 142

12.1 Introduction 142
12.2 To Draw Bar Graphs 143

ANSWERS 151

UNIT I

REVIEW OF THE WORK DONE IN EARLIER CLASSES

A note to the teacher : This is a revision unit. Before going to Unit II, ask the students to attempt all the questions given in this unit. In case of any difficulty, ask them to refer to 'Mathematics for Primary Schools, Book IV'.

EXERCISE 1

1. Write each of the following numbers in figures:
   (i) Eleven thousand twenty three (ii) Seventy thousand seven
   (iii) Ninety thousand nine hundred nine
2. Write each of the following numbers in words:
   (i) 30015 (ii) 10123 (iii) 77077
3. Counting by fives, write the numbers from
   (i) 62523 to 62548 (ii) 19998 to 20028
4. Write 69058 in words and rearrange its digits to get
   (i) the largest 5-digit number. (ii) the smallest 5-digit number.
5. Write the numeral for each of the following:
   (i) 9000 + 9 (ii) 40000 + 40 + 4
   (iii) 5 thousands + 8 hundreds + 7 (iv) 78 thousands + 8
6. In each of the following replace ★ by '<', '>' or '=' so that we get a true statement:
   (i) 50598 ★ 9999 (ii) 60351 ★ 50439
   (iii) 7777 + 23 ★ 7800 (iv) 98358 ★ 98360
7. Observe the pattern and write the next four numbers:
   (i) 68090, 68094, 68098, —, —, —, —.
   (ii) 12359, 12369, 12379, —, —, —, —.
   (iii) 89653, 89753, 89853, —, —, —, —.
   (iv) 88345, 88545, 88745, —, —, —, —.
8. Rewrite in ascending order:
   (i) 50531, 49925, 52130, 48999, 20099 (ii) 60606, 60066, 66006, 60006, 66606
9. Rewrite in descending order:
   (i) 78809, 78908, 78199, 77777, 87000 (ii) 5800, 5008, 5088, 5880, 5888

10. Give the successor of
    (i) 90000
    (ii) 50899

11. Give the predecessor of
    (i) 58063
    (ii) 98000

12. At a particular milk booth the sale of milk, in litres, during a particular week was as follows:

Monday	1008
Tuesday	1359
Wednesday	1505
Thursday	2019
Friday	1983
Saturday	1201
Sunday	2135

How much milk, in all, was sold by the booth during that week?

13. Find the value of
    (i) $23905 + 68099 + 50021$
    (ii) $89630 + 54363 - 68345$
    (iii) $67 \times 256 + 86 \times 256 - 153 \times 256$
    (iv) $48 \times 681 - 681 \times 39 + 681 \times 11$
    (v) 239×144
    (vi) 670×200
    (vii) $250 \times 250 + 35 \times 268$
    (viii) $222 - 448 \times 43 + 625 \times 110$
    (ix) $325 \div 25 + 100$
    (x) $128 \div 4 - 4$
    (xi) $3600 - 500 - 180 \div 60$
    (xii) $666 \div 111 + 5 + 131 \div 131$

14. By means of prime factorization determine all common factors in each of the following pairs of numbers:
    (i) 126, 243
    (ii) 512, 192
    (iii) 850, 125
    (iv) 800, 900

15. An even number is divisible by 3. Is it necessarily divisible by 6? Give reasons in support of your answer.

16. What is the quick way of testing the divisibility of a number by 18?

17. Each of two odd numbers is divisible by 3. Will their sum be always divisible by 6? Give reasons in support of your answer.

18. Determine the H.C.F. of each of the following sets of numbers:
    (i) 35, 42, 63
    (ii) 24, 72, 36

19. Determine the L.C.M. of each of the following sets of numbers:
    (i) 15, 12, 18
    (ii) 25, 30, 50

20. Determine the greatest number which divides 44 and 68 leaving the remainder 8 in each case.

21. Determine the smallest number which when divided by 12, 18 and 40 leaves the remainder 6 in each case.

22. Rewrite each of the following in ascending order:
    (i) $\frac{5}{18}, \frac{7}{24}, \frac{2}{3}, \frac{3}{2}, \frac{1}{4}$
    (ii) $\frac{2}{7}, \frac{4}{35}, \frac{3}{20}, \frac{15}{14}, 1\frac{3}{4}$

23. Rewrite each of the following in descending order:

(i) $\frac{5}{8}, \frac{13}{15}, \frac{9}{16}, \frac{21}{30}$

(ii) $\frac{18}{5}, 3\frac{7}{10}, \frac{2}{15}, \frac{33}{10}$ $\frac{100}{30}$

24. Find the value of

(i) $\frac{2}{3}-\frac{5}{9}+\frac{4}{5}$

(ii) $5-1\frac{1}{3}+2\frac{3}{4}-\frac{17}{12}$

25. Subtract the sum of $5\frac{3}{4}$ and $2\frac{1}{3}$ from the sum of $8\frac{2}{3}$ $\frac{1}{4}$ and $1\frac{1}{2}$.

26. A tin contains 18 litres of kerosene. 11.2 litres of kerosene are taken out one time and 2.6 litres are taken out second time. How much kerosene is left in the tin?

27. Determine the value of

(i) $28.5-32.08+15.2$ (ii) $5-0.5-0.05-0.005$

(iii) $68.3+15.8-31.07+1.5$

28. Add the difference of 258.68 and 481.9 to their sum.

29. A bag contains 35 kg of rice. If seven boys, each eating 100g of rice at a time, eat rice twice a day, how long will the rice last?

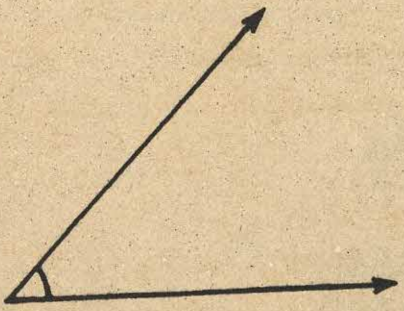
30. Draw angles having the following measures:

(i) 20° (ii) 45° (iii) 70°

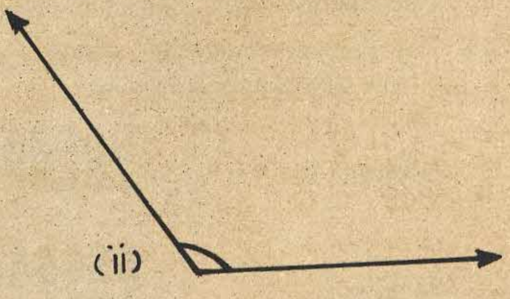
(iv) 130° (v) 170° (vi) 180°

31. In each of the following figures, measure the angle and name the kind of angle:

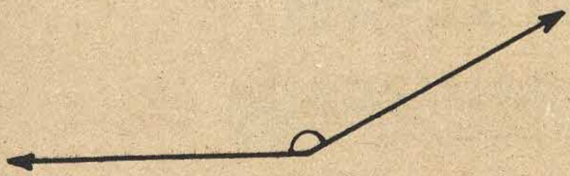
(i)



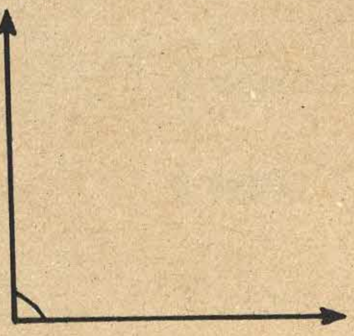
(ii)



(iii)



(iv)



32. With the help of set-squares, draw a line perpendicular to a given line
(i) through a point on it. (ii) through a point outside it.

33. With the help of protractor, draw a line perpendicular to a given line through a point on it.

34. Draw a rectangle whose length and breadth are 5 cm and 4 cm respectively.

35. Draw a square whose side is 6 cm.

36. Determine the kind of Δ ABC for each of the following:
(i) AB = 5 cm, BC = 3 cm, CA = 4 cm (ii) AB = 8 cm, BC = 5 cm, CA = 5 cm
(iii) AB = 3 cm, BC = 3 cm, CA = 3 cm (iv) $\angle A = 40°$, $\angle B = 80°$, $\angle C = 60°$
(v) $\angle A = 40°$, $\angle B = 50°$, $\angle C = 90°$ (vi) $\angle A = 10°$, $\angle B = 30°$, $\angle C = 140°$

37. Which of the following statements are true?
(i) An acute angle is always less than an obtuse angle.
(ii) A 180° angle is called a right angle.
(iii) An isosceles triangle cannot be a right triangle.
(iv) An obtuse triangle may be isosceles.
(v) No angle of an obtuse triangle can be less than 45°.
(vi) In a right triangle, the right angle is the greatest angle.
(vii) A square is always a rectangle.
(viii) A rectangle is always a square.
(ix) Diameter of a circle is its longest chord.

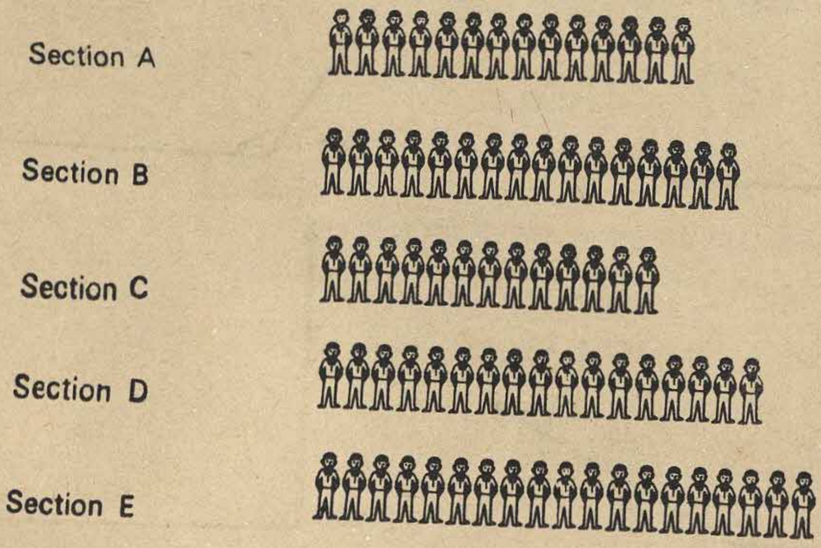
38. Twenty bags of rice of equal weight together weigh 2110 kg 500 g. Determine the weight of
(i) one bag. (ii) 15 bags.

39. Find the area of a floor if it is 15 m 80 cm long and 12 m 90 cm wide. Also, find the perimeter of the floor.

40. What is the cost of carpeting the floor of a room whose length and breadth are respectively 5 m and 3 m, if the cost of carpeting is Rs 20.75 per square metre?

41. A school opens at 7.30 a.m. and closes at 1.30 p.m. For how long does the school remain open?

42. The following pictograph represents the attendance in various sections of Class V of a school on a rainy day in August last year:



(i) In which section was the attendance maximum?
(ii) In which section was the attendance minimum?
(iii) How many students of Class V were present on the rainy day?

43. Observe the pattern and fill in the blanks :

(i) $1 + 3 = 2 \times 2$
$1 + 3 + 5 = 3 \times 3$
$1 + 3 + 5 + 7 = 4 \times 4$
$1 + 3 + 5 + 7 + \ldots = 5 \times 5$
$1 + 3 + 5 + 7 + \ldots + \ldots = 6 \times 6$
$1 + 3 + 5 + 7 + \ldots + \ldots + \ldots = \ldots \times \ldots$

(ii) $2 + 4 = 2 \times 3$
$2 + 4 + 6 = 3 \times 4$
$2 + 4 + 6 + 8 = 4 \times 5$
$2 + 4 + 6 + 8 + \ldots = 5 \times 6$
$2 + 4 + 6 + 8 + \ldots + \ldots = 6 \times 7$
$2 + 4 + 6 + 8 + \ldots + \ldots + \ldots = \ldots \times \ldots$

UNIT II

WHOLE NUMBERS

2.1 Reading and Writing of Numbers

A note to the teacher : The teacher should recall how we wrote numbers up to 99999 by using the digits 0, 1, 2, . . . , 9 and the five places called one's, ten's, hundred's, thousand's and ten-thousand's places. To write the number next to 99999, we open a sixth place called **lakh's place.** We write 1 in this place and 0 in each of the other places on the right. Thus, the number next to 99999 is written as **100000** and is called a **lakh**. To write numbers beyond 100000 we proceed in the same way as we proceeded beyond 10000 and read them successively as **one lakh one, one lakh two**, etc.

The place next to that of lakh is called **ten-lakh's place**. The next higher place is that of **crore** and the next higher is that of **ten-crore**. The names of the places beyond ten-crore are respectively **arab, ten-arab, kharab, ten-kharab**, etc. However, in this book, we shall restrict ourselves to numbers upto ten crores.

To write numbers greater than 100000, we extend the place-value chart that we followed for numbers up to 100000 to the left. The place-value chart now looks as follows:

Periods →	Crores		Lakhs		Thousands		Units		
Places →	Ten crores	Crores	Ten Lakhs	Lakhs	Ten thousands	Thousands	Hundreds	Tens	Ones
	100000000	10000000	1000000	100000	10000	1000	100	10	1

We see that by extending the place-value chart to the left, we are able to write **numerals** for whole numbers greater than 99999 also with the help of only ten symbols 0, 1, 2, 3, 4, 5, 6, 7, 8 and 9 called digits.

We note that the value of a place in the place-value chart is 10 times the value of the next place on its right. Thus,

10 ones = 1 ten
10 tens = 1 hundred

10 hundreds	**=1 thousand**
10 thousands	**=1 ten-thousand**
10 ten-thousands	**=1 lakh**
10 lakhs	**=1 ten-lakh**
10 ten-lakhs	**=1 crore**
10 crores	**=1 ten-crore**

Let us consider the numeral 23456789. We arrange it in place-value chart.

Crores	Ten lakhs	Lakhs	Ten thousands	Thousands	Hundreds	Tens	Ones
10000000	1000000	100000	10000	1000	100	10	1
2	3	4	5	6	7	8	9

The place values of various digits are as follows:

Digit	**Place Value**
2	20000000
3	3000000
4	400000
5	50000
6	6000
7	700
8	80
9	9

The sum of the place values of its digits is the number represented by the numeral. When we write a number as the sum of the place values of its digits, we call it the **expanded form** of the numeral. Thus, the expanded form of 23456789 is '20000000+3000000+400000+50000+ 6000+700+80+9'. To read numbers conveniently, we group place values into periods. 'Crores', 'Lakhs', 'Thousands' and 'Units' are periods. The first three digits from the right of a numeral make unit's period, the next two make thousand's period, the next two make lakh's period, the next two make crore's period, and so on. The digits in the same period are read together and the name of the period (except units) is read along with them. Thus, the number 23456789 is read as 'Two crore thirty-four lakh fifty-six thousand seven hundred eighty nine'.

Sometimes, for reading periods with ease, we insert a comma (,) after each period. Thus, the numeral 23456789 is sometimes written as 2,34,56,789. When a number is given in words and we want to write the corresponding numeral, i.e., the number in figures, we must put the digits in proper places and fill each vacant place by a zero. Thus, the number 'three crore seventy six' is written as 30000076. (Why?)

EXERCISE 2(i)

1. Write each of the following in figures:
   (i) Seven crore twenty lakh fifty-eight thousand five hundred sixty four
   (ii) Nine crore seven lakh ten thousand two hundred three
   (iii) Three crore seven thousand seven
   (iv) One crore ninety-eight thousand seventy six
   (v) Twenty-nine lakh twenty-nine thousand twenty nine
   (vi) Five crore five

2. Write each of the following numbers in words:
   (i) 14345876 (ii) 99005067
   (iii) 66666666 (iv) 40003201
   (v) 50060060 (vi) 70000070

3. Counting by twos write the numbers from
   (i) 9999997 to 10000003
   (ii) 4009998 to 4010002

4. Counting by hundreds write the numbers from
   (i) 6009909 to 6010209
   (ii) 99985 to 100485

5. Counting by thousands write the numbers from
   (i) 7439215 to 7443215
   (ii) 16999075 to 17002075

6. Counting by threes write the numbers in reverse order from 10000004 to 9999995.

7. Which number is 1000 more than 900999?

8. Which number is 1000 less than 10000000?

9. Find the difference of the place values of two 5's in 35087560.

10. Find the product of the place values of two 3's in 123030.

11. Write in expanded form:
   (i) 348675 (ii) 7005001

12. Write the greatest 8-digit number.

13. Write the smallest 7-digit number.

14. Write 403789561 in words and then
   (i) rearrange the digits to name the largest number.
   (ii) rearrange the digits to name the smallest number.

*15. Write the greatest 7-digit number having at least three different digits.

*16. Write the smallest 7-digit number having at least three different digits.

17. Memorise the following facts and write in words:
   (i) Diameter of the sun: 1384000 km approximately
   (ii) Distance of the sun from the earth: 148800000 km approximately
   (iii) The speed of light: 298300 km per second approximately
   (iv) The Population of India:
      In 1971 : 546955945
      In 1981 : 683810051

2.2 Ordering of Numbers

To compare large numbers, we follow the same rules that we follow in case of small numbers.

Rule 1 : **Of the two numbers, the one containing more number of digits is greater.** For example,

$10245132 > 8974655$
$100000000 > 65004879$

Rule 2 : **If the two numbers contain the same number of digits, we compare them by their leftmost digits; if they are also the same, we compare them by their next digits from the left; and so on.** For example,

$3240651 > 1245689$
$62732101 > 62730211$

Example 1: How many numbers have exactly
(i) 2 digits? (ii) 3 digits? (iii) 4 digits?

Solution : (i) The smallest 2-digit number is 10 and the greatest is 99. Therefore, the number of 2-digit numbers is $99 - 9$ (why?), i.e., 90.

(ii) The number of 3-digit numbers $= 999 - 99$
$= 900$

(iii) The number of 4-digit numbers $= 9999 - 999$
$= 9000$

EXERCISE 2(ii)

1. Replace each ★ by '<', >' or '=' so that we get a true statement:
   (i) 54123 ★ 321045
   (ii) 67984021 ★ 67908421
   (iii) 999999 + 1 ★ 1000000
   (iv) 40000000 − 1 ★ 49999999
   (v) 1234560 ★ 1023456
   (vi) 6009006 ★ 6006006 + 3000
2. Rewrite in ascending order with proper symbol:
   (i) 423569, 235694, 356942, 569423, 694235
   (ii) 1000000, 888888, 84036, 30006812, 900000
   (iii) 10101010, 10000111, 11001100, 11010010, 10010011
3. Rewrite in descending order with proper symbol:
   (i) 8935706, 8935076, 8930576, 8963570, 8936750
   (ii) 36604518, 9863827, 52186307, 10004008, 9876000
   (iii) 2200222, 2220022, 2202022, 2220202, 2222020
4. Give the successor of
   (i) 70000000 (ii) 8999999
5. Give the predecessor of 50000000.
6. How many numbers have exactly
   (i) 7 digits? (ii) 8 digits?

2.3 Operations and Properties

A note to the teacher : The teacher should state that the four fundamental operations namely, addition, subtraction, multiplication and division of large numbers are performed in exactly the same way as for smaller numbers studied in earlier classes. Also, the same basic properties of operations, that hold for small numbers, also hold for large numbers.

EXERCISE 2(iii)

1. Find the sum:
   (i) 6798235 + 5610723 (ii) 423146 + 69120087 (iii) 67676767 + 67676767
   (iv) 14029875 + 349 + 4013275 (v) 99 + 999 + 9999 + 99999 + 999999
2. Replace each ★ by the correct digit in each of the following:

(i)
$$\begin{array}{r} 3\;9\;\bigstar\;4\;6\;8 \\ +\quad \bigstar\;9\;7\;\bigstar\;\bigstar \\ \hline \bigstar\;9\;1\;\bigstar\;4\;5 \\ \hline \end{array}$$

(ii)
$$\begin{array}{r} 6\;\bigstar\;5\;\bigstar\;4\;\bigstar\;3\;\bigstar \\ +\quad 2\;\bigstar\;1\;\bigstar\;0\;\bigstar\;9 \\ \hline \bigstar\;0\;2\;9\;1\;8\;1\;6 \\ \hline \end{array}$$

3. Find the difference:
   (i) 6431875 − 5643187 (ii) 8170040 − 31259
   (iii) 70012954 − 8888888 (iv) 24136975 − 24136975
   (v) 50000000 − 9999999 (vi) 10101010 − 878787
4. How much more is 40000000 than 575000?
5. What must be added to 6973120 to make it equal to 7000000?
6. Subtract the sum of 98432 and 6751803 from 20403078.
7. Subtract the difference of 767676 and 67676767 from their sum.
8. Simplify:
   (i) 694825 × 69 + 31 × 694825
   (ii) 7543 × 894576 − 6543 × 894576
   (iii) 69 × 421863 + 15 × 421863 + 421863 × 16
   (iv) 6943208 × 99 + 6943208
   (v) 204658 × 98 + 26 × 204658 − 204658 × 24
   (vi) 694128 × 97 + 694128 + 694128 + 694128
9. Find the product:
   (i) 36875 × 250 (ii) 601372 × 403
   (iii) 2712 × 5681 (iv) 56821 × 3000
   (v) 2526 × 5000 (vi) 5025 × 5025
10. Using only three partial products multiply
    (i) 61425 by 3665 [Hint: 36 = 6 × 6]
    (ii) 123456 by 75153 [Hint: 75 = 15 × 5]
11. Find the value of
    (i) 703498 + 675 × 60000 (ii) 1625 × 1625 − 1625

(iii) $1625 \times (1625 - 1625)$
(iv) $6006006 - 7842 \times 120$
(v) $4000 + 640 \times 640$
(vi) $(400 + 640) \times 640$

12. Divide orally and give the quotient and the remainder:
(i) $63841507 \div 1000$
(ii) $417500 \div 100$
(iii) $618430 \div 100$
(iv) $5120078 \div 1000$
(v) $5120078 \div 10000$
(vi) $10000004 \div 100000$

13. Divide and check the result:
(i) $7512006 \div 350$
(ii) $6941205 \div 2657$
(iii) $10203040 \div 1234$
(iv) $7000000 \div 777$
(v) $1001006 \div 9876$
(vi) $53184007 \div 53184007$

14. Find the value of
(i) 36792418×0
(ii) $94125807 + 0$
(iii) 7300654×1
(iv) $6782058 \div 6782058$
(v) $973281 \div (7975 \div 7975)$
(vi) $8423615 \times 10007 - 7 \times 8423615$
(vii) $369369 \div (544 - 421)$
(viii) $691200 \div (12 \times 900)$
(ix) $1740 + 5800 \times 15 - 20000 \div 400$
(x) $87506 + 87506 \div 87506$
(xi) $1 - 3984275 \div 3984275$
(xii) $0 \div 79738412$

15. A survey report gave the number of males and females in a country as 115623203 and 115075428 respectively. Determine the population of the country.

16. In a parliamentary election the winning candidate received 367570 votes and his nearest rival 298685 votes. By how much margin did the winner win?

17. In a board examination, 1155768 candidates appeared. 876080 candidates passed. How many failed?

18. A machine, on an average, manufactures 2825 screws in a day. How many screws did it manufacture in the year 1980?

19. An automobile firm manufactured 1250 scooters in a month. If the price of one scooter is Rs 7825.50, find the cost of the whole production by the firm for the month (30 days).

20. An industrialist had property worth Rs 274654350. The whole property is to be equally divided among his two sons and a daughter. Find the share of each.

21. An aeroplane, on an average, covers 6000 km in 12 hours. How much distance will it cover in 12 days?

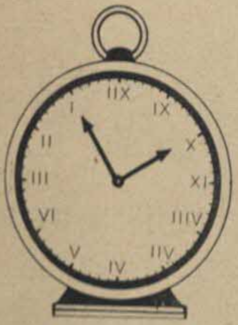
22. An engine pumps out 94500 litres of water in half an hour. How many litres of water will it pump out in a day if operated continuously?

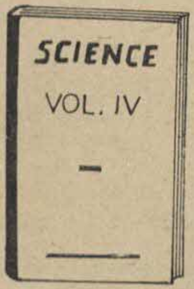
*23. An organisation spends Rs 720000 per day on daily wage workers. Each worker gets Rs 12 a day. The organisation increases the fleet of workers by 4000. How much will the organisation now spend on such workers per day?

★2.4 Roman System of Numeration

A note to the teacher : The teacher should note that the Sections 2.4 and 2.5 of this unit are not for the examination for promotion to Class VI. However, for clear understanding of our number system known as Hindu-Arabic system of numeration through comparison, we have given them here.

Roman numerals are still in use today. The chapters of this book are numbered by Roman numerals. We find a number of clocks with hours on their faces (dials) marked by Roman numerals. Roman numerals are also used to inscribe a date on a gravestone, to number different volumes of various books, to number classrooms in a school, etc.





The Roman symbols and the corresponding Hindu-Arabic numerals are as given below:

Roman symbol	I	V	X	L	C	D	M
Hindu-Arabic symbol	1	5	10	50	100	500	1000

To read and write numbers in this system, we use the following rules:

Rule 1: If a symbol is repeated in succession, the value of the numeral is obtained by multiplying the value of the symbol by the number of times it is repeated.

Examples: $\mathrm{XXX} = 10 \times 3 = 30$
$\mathrm{CC} = 100 \times 2 = 200$

We usually do not repeat in succession a symbol more than three times. V, L and D are not repeated. (Why?)

Rule 2: If a symbol is inserted on the right of one of greater value, we add its value to the value of the symbol on the right of which it occurs.

Examples : $\mathrm{VI} = 5 + 1 = 6$
$\mathrm{XXV} = 10 \times 2 + 5 = 25$
$\mathrm{MMMCCX} = 1000 \times 3 + 100 \times 2 + 10 = 3210$

Rule 3: If a symbol is inserted on the left of one of greater value, we subtract its value from the value of the symbol on the left of which it occurs.

Examples: IX = 10 − 1 = 9
XL = 50 − 10 = 40
MCMLIX = 1000 + (1000 − 100) + 50 + (10 − 1) = 1959

In the use of this rule, we have the following restrictions:

(i) I can be subtracted from V and X only.
(ii) X can be subtracted from L and C only.
(iii) C can be subtracted from D and M only.
(iv) V, L, D and obviously M are not subtracted.

Rule 4: When a smaller numeral, which itself is made up of two symbols by using Rule 3, is to be added to a larger numeral, the whole of it is inserted on the right of the larger one.

Examples: CIV = 100 + (5 − 1) = 104
DCXC = 500 + 100 + (100 − 10) = 690

Rule 5: When a small horizontal line (–), called bar, is inserted over a numeral, we get the value of the numeral as 1000 times the value of the numeral without bar.

Examples: $\overline{\text{V}} = 5 \times 1000 = 5000$
$\overline{\text{XVII}} = 17 \times 1000 = 17000$
$\overline{\text{V}}\text{III} = 5 \times 1000 + 3 = 5003$

Within the frame work of the above rules, the Roman numerals are arranged in order with the symbol representing the largest number placed on the left and that representing the smallest placed on the right. The symbols which do not obey the above rules are meaningless. For Example, each of XXL, DMCD, IIV is meaningless.

Example 2 : Give the corresponding Hindu-Arabic numeral for
(i) CMLXVI (ii) MLXXXVI (iii) $\overline{\text{IV}}\text{CDIX}$

Solution : (i) CMLXVI = (1000 − 100) + 50 + 10 + 5 + 1
= 900 + 50 + 10 + 5 + 1
= 966
(ii) MLXXXVI = 1000 + 50 + (3 × 10) + 5 + 1
=1086
(iii) $\overline{\text{IV}}\text{CDIX}$ = (4 × 1000) + (500 − 100) + (10 − 1)
= 4409

Example 3: Give the corresponding Roman numeral for
(i) 16 (ii) 244 (iii) 3479 (iv) 200594

Solution : (i) 16 = 10 + 5 + 1
= XVI

(ii) $244 = 200 + 40 + 4$
$= 200 + (50 - 10) + (5 - 1)$
$=$ CCXLIV

(iii) $3479 = 3000 + 400 + 70 + 9$
$= 3 \times 1000 + (500 - 100) + 50 + 20 + (10 - 1)$
$=$ MMMCDLXXIX

(iv) $200594 = 200000 + 500 + 90 + 4$
$= \underline{200} \times 1000 + 500 + (100 - 10) + (5 - 1)$
$= \overline{\text{CC}}\text{DXCIV}$

EXERCISE 2(iv)

1. Give the corresponding Hindu-Arabic numeral for
   - (i) XI
   - (ii) XVII
   - (iii) LXIII
   - (iv) MCLVI
   - (v) CCLI
   - (vi) MMCCCXXX
   - (vii) XCI
   - (viii) CDIX
   - (ix) $\overline{\text{X}}\text{XX}$
   - (x) $\overline{\text{IX}}\text{DCCCLXXIX}$
   - (xi) $\overline{\text{VII}}\text{CDXLIV}$
   - (xii) $\overline{\text{M}}\text{MMCMXLVIII}$

2. Give the corresponding Roman numeral for
   - (i) 8
   - (ii) 19
   - (iii) 36
   - (iv) 45
   - (v) 69
   - (vi) 127
   - (vii) 445
   - (viii) 6000
   - (ix) 7608
   - (x) 5002
   - (xi) 68210
   - (xii) 100000

3. Which of the following numerals are meaningless?
   - (i) IXIV
   - (ii) CCCI
   - (iii) ICC
   - (iv) CIC
   - (v) $\overline{\text{V}}\text{XXXIX}$
   - (vi) CMXIV
   - (vii) MC
   - (viii) DM
   - (ix) MXXVII
   - (x) LCXVI
   - (xi) $\overline{\text{C}}\text{CDV}$
   - (xii) $\overline{\text{X}}\text{XV}$

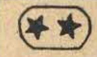
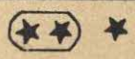
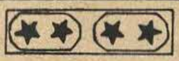
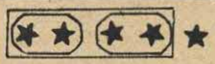
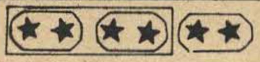
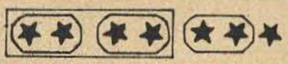
★2.5 The Binary or Base-2 Numeration System

We recall that our system of numeration, namely, the Hindu-Arabic system of numeration is a base-10 system. In this system, we represent number of objects by means of groupings by tens. For a group of 10, we write 1 in ten's place; for a group of 100, i.e., 10 tens, we write 1 in hundred's place and so on. Instead of groupings by tens, we can group number of objects by some other number. Thus, a system of numeration can be very easily constructed on any base similar to base-10 by using an appropriate number of digits and the place-value principle. In **binary** or **base-2** system, for example,

(i) **we use only two digits, namely, 0 and 1**, and
(ii) **we determine place values in groups of twos rather than in groups of tens.**

This system has its importance because of modern computing machines. Since an electric switch has only two possible positions—on or off—a machine can represent numbers by a series of 'on' and 'off' switches. A 'switch on' represents the numeral 1 and a 'switch off' represents the numeral 0.

Let us see how we write numbers in this system.

Number of objects	Base-10	Base-2
	1	1
	2	10
	3	11
	4	100
	5	101
	6	110
	7	111

The places, therefore, starting from the right are named as **one's place, two's place, four's place, eight's place**, etc.

A note to the teacher : The teacher should explain that 0 and 1 here used as digits for writing numerals in binary system are merely symbols. In place of them we could use other symbols like △ and □. 0 and 1 in binary system should not be confused with the digits 0 and 1 in base-10 system. For example '11' in binary system should not be confused with '11' (eleven) in base-10 system. In binary system we read this as 'one one'. Similarly '101' will be read as 'one zero one'.

To differentiate a numeral in base-2 from that in base-10, we subscript the word 'two' parenthetically with the numeral in base-2, e.g., $11_{(two)}$.

The place-value chart takes the following form:

Sixty fours	Thirty twos	Sixteens	Eights	Fours	Twos	Ones
2×2×2×2×2×2	2×2×2×2×2	2×2×2×2	2×2×2	2×2	2	1

To convert a base-2 numeral to the corresponding base-10 numeral, we express the numeral in expanded form (i.e., as an indicated sum) where each addend is expressed by a numeral in base-10.

Example 4 : Convert $111011_{(\text{two})}$ to the corresponding base-10 numeral.

Solution : We write the numeral in expanded form. The successive place values in base-2 are expressed in base-10.

Thirty-twos	Sixteens	Eights	Fours	Twos	Ones
32	16	8	4	2	1
1	1	1	0	1	1

$$\begin{aligned}\text{Thus, } 111011_{(\text{two})} &= 1\times 32 + 1\times 16 + 1\times 8 + 0\times 4 + 1\times 2 + 1\times 1\\ &= 32 + 16 + 8 + 0 + 2 + 1\\ &= 59\end{aligned}$$

To convert a base-10 numeral to the corresponding base-2 numeral, we form groups of twos, fours, eights, etc. In other words, we repeatedly subtract twos, fours, eights, etc. For this, we repeatedly divide by 2. The remainders in succession give ones, twos, fours, etc.

Example 5 : Convert 59 to the corresponding base-2 numeral.

Solution : We divide 59 by 2 repeatedly and have

2	59		
2	29 ,	remainder 1	← one's place
2	14 ,	remainder 1	← two's place
2	7 ,	remainder 0	← four's place
2	3 ,	remainder 1	← eight's place
2	1 ,	remainder 1	← sixteen's place
	0 ,	remainder 1	← thirty-two's place

Therefore, $59 = 111011_{(\text{two})}$

EXERCISE 2(v)

1. Convert the following base- 2 numerals to the corresponding base- 10 numerals:

(i) 11 (ii) 110 (iii) 111
(iv) 101 (v) 1101 (vi) 11001

(vii) 1000
(viii) 11111
(ix) 10101
(x) 10011
(xi) 10111
(xii) 11110

2. Convert the following base-10 numerals to the corresponding base-2 numerals:

(i) 4
(ii) 12
(iii) 23
(iv) 14
(v) 68
(vi) 19
(vii) 33
(viii) 40
(ix) 29
(x) 52
(xi) 70
(xii) 85

3. Write the smallest 3-digit base-2 numeral. Give its corresponding decimal numeral.

4. Write the greatest 4-digit base-2 numeral. Give its corresponding decimal numeral.

UNIT III

FACTORS AND MULTIPLES

3.1 Some Properties of Divisibility

In Class IV we studied tests of divisibility for certain numbers. Simply bv looking at the digits in the numeral of a number, we were able to say definitely whether the given number is divisible by 2, 3, 5, 9 or 10. We now state some other properties of divisibility which help us in determining the divisibility of a number by certain other numbers.

(i) If a number is divisible by another number, it must be divisible by each factor of that number.

Example : 20 is divisible by 10 since $20 \div 10 = 2$
Also, $10 = 2 \times 5$
Therefore, 20 should be divisible by 2.
Obviously it is, since $20 \div 2 = 10$
Similarly, 20 should be divisible by 5.
Obviously it is, since $20 \div 5 = 4$

In the above example, we see that 20 is divisible by 10 and 10 is divisible by 2 (or 5). We find that 20 is divisible by 2 (or 5) also. Thus we can say:

If we are given three numbers such that the first number is divisible by the second and the second is divisible by the third, then the first must be divisible by the third.

(ii) If a number is divisible by each of two or more coprime numbers, it must be divisible by their product.

Example : 60 is divisible by 2 since $60 \div 2 = 30$
60 is divisible by 3 since $60 \div 3 = 20$
60 is divisible by 5 since $60 \div 5 = 12$

We recall that two numbers are coprime if their H.C.F. is 1. Here 2, 3 and 5 are coprime numbers.

Therefore, 60 must be divisible by $2 \times 3 \times 5$, i.e.. 30.
Obviously it is, since $60 \div 30 = 2$

Important Note : To test the divisibility of a number by certain other number, we may test its divisibility by such coprime factors of that number whose product is that number itself. For example, to find out whether 32610 is divisible by 15, we test the divisibility of 32610 by 3 and 5 which are two coprime factors of 15 and 3 × 5 = 15. We find that 321610 is divisible by both 3 and 5. (Why?) Therefore, 32610 must be divisible by 15.

(iii) **If a number is a factor of each of two or more given numbers, it must be a factor of their sum.**

Example : 5 is a factor of 15. (Why?)
5 is a factor of 40. (Why?)
Therefore, 5 must be a factor of 15 + 40, i.e., 55.
Obviously it is, since 55 ÷ 5 = 11

(iv) **If a number is a factor of each of two given numbers, it must be a factor of their difference.**

Example : 6 is a factor of 54. (Why?)
6 is a factor of 78. (Why?)
Therefore, 6 must be a factor of 78 − 54, i.e., 24.
Obviously it is, since 24 ÷ 6 = 4

3.2 Divisibility by 4 and 8

We know that

(i) 100 is divisible by 4, since 100 ÷ 4 = 25

(ii) 1000 is divisible by 8, since 1000 ÷ 8 = 125

Let us now consider the divisibility of 34516 by 4.

$$34516 = 34500 + 16$$
$$= 345 \times 100 + 16$$

345 × 100 is divisible by 4, since

$$(345 \times 100) \div 4 = \frac{345 \times 100}{4} = 345 \times 25$$

16 is divisible by 4, since 16 ÷ 4 = 4

Therefore, 34516 is divisible by 4. (Why?)

We note that every whole number can be written in the form "A whole number × 100 + the number formed by the digits in ten's and one's places."

Therefore, we conclude:

A number must be divisible by 4 if the number formed by its digits in ten's and one's places is divisible by 4

Now, $34516 = 34000 + 516$
$= 34 \times 1000 + 516$

34 × 1000 is divisible by 8, since

$$(34 \times 1000) \div 8 = \frac{34 \times 1000}{8} = 34 \times 125$$

516 is not divisible by 8, since 516 ÷ 8 = 64, *remainder* 4.

Therefore, 34516 is not divisible by 8. (Why?)

Let us, now consider the number 19872.

$$\begin{aligned} 19872 &= 19000 + 872 \\ &= 19 \times 1000 + 872 \end{aligned}$$

The hundred's, ten's and one's digits of 19872 make the number 872 which is divisible by 8, since

872 ÷ 8 = 109

Hence, the number 19872 must be divisible by 8. (Why?)

We note that every whole number can be written in the form

"A whole number × 1000 + the number formed by the digits in hundred's, ten's and one's places."

Therefore, we conclude :

A number must be divisible by 8 if the number formed by its digits in hundred's, ten's and one's places is divisible by 8.

Example 1 : Is 432 divisible by 36?

Solution : We note that 36 = 4 × 9.

We also note that 4 and 9 are coprime factors of 36.

Now, 432 is divisible by 4, since 32 is divisible by 4.
[32 ÷ 4 = 8]

432 is divisible by 9, since 4 + 3 + 2, i.e., 9 is divisible by 9.

Hence, 432 is divisible by the product 4 × 9, i.e., 36.

Example 2 : A number is divisible by both 4 and 6. Is it necessarily divisible by their product 4 × 6, i.e., 24? If not, illustrate by means of an example.

Solution : No, the number may not be divisible by 4 × 6, since 4 and 6 are not coprime. (Why?)

For example, 36 is divisible by 4, since 36 ÷ 4 = 9
36 is divisible by 6, since 36 ÷ 6 = 6
But, 36 is not divisible by 4 × 6, i.e., 24, since 36 ÷ 24 = 1, remainder 12

Example 3 : Is 882 divisible by 9? Which two numbers nearest to 882 are divisible by 9?

Solution : 882 is divisible by 9, since 8 + 8 + 2, i.e., 18 is divisible by 9.

Also, the first multiple of 9 is 9.

S.C.E.R.T., West Bengal
Date...12/12/84
Acc. No...3067

Therefore, 882 + 9, *i.e.*, 891 and 882 − 9, *i.e.*, 873 must be divisible by 9. 891 and 873 are nearest to 882 each divisible by 9. (Why?)

EXERCISE 3(i)

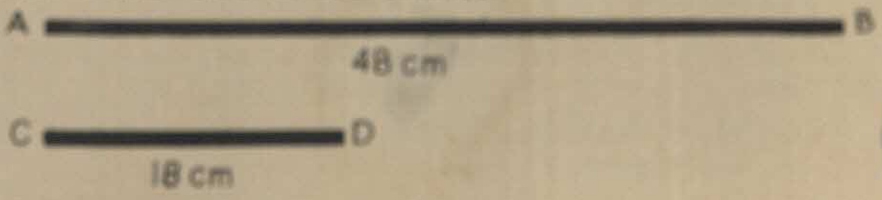
1. In each of the following, without actual division, determine whether the first number is divisible by the second :
   - (i) 4236; 6
   - (ii) 54812; 12
   - (iii) 60006; 12
   - (iv) 713452; 4
   - (v) 961572; 8
   - (vi) 961072; 8
   - (vii) 450450; 90
   - (viii) 6034170; 20
   - (ix) 217500; 15
   - (x) 9246285; 45
   - (xi) 6432008; 80
   - (xii) 1234500; 300
2. Use divisibility tests to determine whether 10026 is divisible by both of 2 and 3. Is 10026 divisible by 6?
3. What is the quick way of testing the divisibility of a number by 45?
4. 4 divides 660. 6 also divides 660. Does the product of 4 and 6 *necessarily* divide 660?
5. Test the divisibility of 10227 and 354354 by 3. Is their sum divisible by 3? Why or why not? Is their difference divisible by 3? Why or why not?
6. A number is divisible by 18. Is it *necessarily* divisible by 9?
7. 7 divides 35 and 35 divides 595. Does 7 divide 595? Why or why not?
8. Is 12345 + 528 divisible by 15? Why or why not?
9. It is given that 156250 is divisible by 250. Which two numbers nearest to 156250 are divisible by 250?
10. Which of the following statements are true?
    - (i) If a number is divisible by two odd numbers, it must be divisible by their product.
    - (ii) If a number is divisible by 14, it must be even and divisible by 7.
    - (iii) If a number is divisible by each of two different numbers, it must be divisible by their product.
    - (iv) If a number is a factor of each of two or more numbers, it must also be a factor of their product.
    - (v) The sum of two even numbers is also an even number.
    - (vi) The sum of two consecutive odd numbers is always divisible by 4.

      [Hint: The sum of two consecutive odd numbers is two times the whole number between them.]

3.3 Division Method of Finding H.C.F.

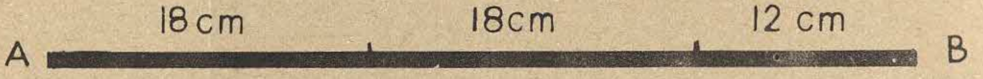
Let us discuss the method by means of an example.

Sridhar has two iron rods (AB and CD shown below) of lengths 48 cm and 18 cm respectively. He wants to find the length of the largest rod by which he can measure each of these rods an exact number of times.

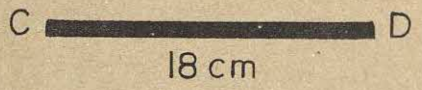


S.C.E.R.T., West Bengal Library Calcutta

Obviously he can have a rod of length 1 cm and measure each of the two rods an exact number of times. This gives rise to the fact that when no prime factor is common to two given numbers, 1 will always be a common factor. But, Sridhar wants the largest rod of that type. Let us see how we get the length of such a rod. Definitely the length of such a rod must divide 48 cm and 18 cm exactly. Therefore, it must be the H.C.F. of 48 cm and 18 cm.



We cut the larger rod (of length 48 cm) into pieces each equal to the length of the smaller rod (18 cm). We get two such pieces and a length of 12 cm is left.



We divide 48 by 18.

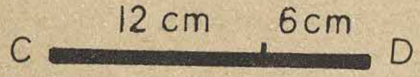
$$\begin{array}{r} 2 \\ 18\,\overline{)\,48} \\ \underline{36} \\ \underline{12} \end{array}$$

We get the quotient 2 and remainder 12.

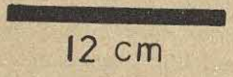
The rod which will measure CD an exact number of times, will obviously measure the two pieces (each of length 18 cm) obtained above an exact number of times.

Therefore, the required rod must measure the remaining portion of the larger rod, i.e., 12 cm and 18 cm an exact number of times

Next, we cut the rod CD (18 cm) into pieces each equal to the length 12 cm. We get one such piece and a length of 6 cm is left.



Next, we divide 18 (the first divisor) by 12 (the first remainder).



$$\begin{array}{r} 1 \\ 12\overline{)18} \\ \underline{12} \\ \underline{6} \end{array}$$

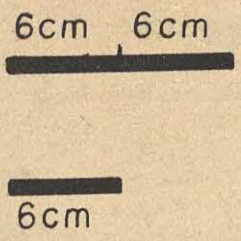
We get the quotient 1 and remainder 6.

The rod which will measure a piece of 12 cm an exact number of times will obviously measure the 12 cm piece cut from CD an exact number of times.

Therefore, the required rod must measure the remaining portion of CD, i.e., 6 cm and 12 cm an exact number of times.

We now cut the 12 cm piece into pieces each equal to the length 6 cm. We get exactly two such pieces and no portion of the piece is left.

Obviously the required largest rod, that will measure both the given rods an exact number of times, must be of length 6 cm.



We now divide 12 (the second divisor) by 6 (the second remainder).

2
6) 12
12
0

We get the quotient 2 and remainder 0.

The required H.C.F. of the given numbers (i.e., 48 and 18) is 6 (the last divisor in the process when remainder is zero.)

What have we done? To obtain the H.C.F. of 48 and 18, we divide 48 by 18. Remainder is 12. Next, we divide the divisor (i.e., 18) by the remainder 12. Second remainder is 6. Finally, we divide the second divisor (i.e., 12) by the second remainder (i.e., 6). The remainder is 0.

The last divisor (i.e., 6) is the H.C.F. of 48 and 18.

Briefly,

First divisor → 18) 48 (2
36
First remainder (second divisor) → 12) 18 (1
12
6) 12 (2
Second remainder(third divisor) ↗ 12
0

The last divisor, i.e., 6 is the H.C.F. of 48 and 18.

In view of the above, to find the H.C.F. of two numbers, we take the following steps:

Step 1 : We divide the larger number by the smaller.

Step 2 : Next, we divide the divisor by the remainder obtained in Step 1.

Step 3 : We then divide the new divisor of Step 2 by the new remainder of Step 2.

Step 4 : We continue the process like Step 3 till we get zero as the remainder.

Step 5 : We write the last divisor as the H.C.F. of the given numbers.

The above method of finding the H.C.F. of two numbers is called the **division method of finding H.C.F.** This is more useful when the numbers are large.

Example 4: Find the H.C.F. of 552 and 408.

Solution : We divide 552 by 408. Remainder is 144. Next, we divide 408 by 144. Remainder is 120. We continue as on the right till we get zero as the remainder.

The last divisor, i.e., 24 is the required H.C.F. of 552 and 408.

```
408 ) 552 ( 1
      408
      ---
      144 ) 408 ( 2
            288
            ---
            120 ) 144 ( 1
                  120
                  ---
                   24 ) 120 ( 5
                        120
                        ---
                          0
                        ---
```

In order to find the H.C.F. of three numbers, we take the following steps:

Step 1 : We first find the H.C.F. of any two of the given numbers.

Step 2 : We then find the H.C.F. of the third number and the H.C.F. obtained in Step 1.

Step 3 : We write the H.C.F. obtained in Step 2 as the required H.C.F. of the given numbers.

Example : Find the H.C.F. of 200, 300 and 325.

Solution : H.C.F. of 200 and 300 is 100.

```
200 ) 300 ( 1
      200
      ---
      100 ) 200 ( 2
            200
            ---
              0
            ---
```

The required H.C.F. of the given numbers must be the H.C.F. of 100 and 325.

H.C.F. of 100 and 325 is 25. Therefore, the H.C.F. of 200, 300 and 325 is 25.

```
100 ) 325 ( 3
      300
      ---
       25 ) 100 ( 4
            100
            ---
              0
            ---
```

EXERCISE 3(ii)

Find the H.C.F. for each of the following:

1. 30, 42
2. 27,63
3. 18,45
4. 24, 60
5. 50, 75
6. 84, 112
7. 76, 95
8. 161, 230
9. 12, 45, 75
10. 18, 54, 81

11. 72, 90, 198
12. 85, 300, 450
13 528, 904
14. 108, 144, 216
15. 130, 442, 1261
16. 210, 455, 910
17. 180, 252, 576
18. 605, 935, 1320
19. 1624, 522, 1276
20. 2241, 8217, 747

3.4 Division Method of Finding L.C.M.

We recall that the lowest common multiple (L.C.M.) of two or more numbers is the smallest (other than zero) of their common multiples. For example, the L.C.M. of 4 and 6 is 12, as common multiples of 4 and 6 are 12, 24, 36, 48, . . .and 12 is the smallest of them.

To find the L.C.M. of two or more numbers, we set aside all common factors of two or more of the given numbers. The product of the common factors set aside and of those that remain is the required L.C.M. This can easily be done as shown below in Example 6.

Example 6 : Find the L.C.M. of 48, 56, 72 and 108.

Solution : We set common prime factors aside as follows:

2	48	56	72	108
2	24	28	36	54
2	12	14	18	27
3	6	7	9	27
3	2	7	3	9
	2	7	1	3

$$\begin{aligned}\text{Therefore, L.C.M.} &= 2 \times 2 \times 2 \times 3 \times 3 \times 2 \times 7 \times 1 \times 3 \\ &= 3024\end{aligned}$$

Therefore, to find the L.C.M. of two or more numbers, we can state the following steps to be taken :

Step 1 : We write all numbers in a row with some space between each pair of consecutive numbers.

Step 2 : As long as a prime number divides two or more of the given numbers, we set the prime number aside and carry out division.

Step 3 : We put the quotients directly under the given numbers in the next row. If a number is not divisible by the chosen divisor, we extract the number itself in the next row.

Step 4 : We continue the process of Steps 2 and 3 till finally all coprime numbers are left in the last row.

Step 5 : We find the product of all the numbers set aside and those left over in the last row. The product obtained in Step 5 is the required L.C.M. of the given numbers.

3.5 The Product of H.C.F. and L.C.M. of Two Numbers

The H.C.F. and L.C.M. of any two numbers have the following property :

The product of H.C.F. and L.C.M. of two numbers equals the product of the numbers.

Let us, for example, consider numbers 12 and 16.
H.C.F. of 12 and 16 = 4
L.C.M. of 12 and 16 = 48
Product of H.C.F. and L.C.M. = $4 \times 48 = 192$
Product of the numbers = $12 \times 16 = 192$

A note to the teacher: The teacher should illustrate this property by means of other pairs of numbers.

Example 7 : The H.C.F. and L.C.M. of two numbers are respectively 3 and 180. If one of the numbers is 12, find the other.

Solution : Product of H.C.F. and L.C.M. = 3×180.

Therefore, $12 \times$ second number = 3×180
i.e., 12 times second number = 3×180

$$\text{Therefore, second number} = (3 \times 180) \div 12 = \frac{3 \times 180}{12} = 45$$

Example 8 : If the H.C.F. of two numbers is 28 and their product is 9408, find their L.C.M.

Solution : We know that
H.C.F. × L.C.M. = product of the numbers
Thus, 28 times L.C.M. = 9408

$$\text{Therefore, L.C.M.} = \frac{9408}{28} = 336$$

EXERCISE 3(iii)

1. Find the L.C.M. for each of the following sets of numbers :
   (i) 4, 5, 6
   (ii) 8, 12, 16.
   (iii) 15, 20, 60
   (iv) 40, 48, 56

(v) 42, 105, 147 (vi) 108, 135, 162
(vii) 132, 210, 308 (viii) 180, 144, 324
(ix) 112, 168, 266 (x) 120, 210, 330
(xi) 6, 8, 10, 12 (xii) 24, 48, 72, 144

2. For each of the following pairs of numbers show that the product of their H.C.F. and L.C.M. equals their product :
   (i) 21, 24 (ii) 30, 40
   (iii) 45, 63 (iv) 72, 90
   (v) 61, 61 (vi) 117, 221

3. Find the H.C.F. of the numerator and the denominator of each of the following fractions and thereby reduce it to lowest terms:
   (i) $\frac{76}{95}$ (ii) $\frac{115}{483}$
   (iii) $\frac{85}{221}$ (iv) $\frac{141}{470}$

4. In each of the following, make the fractions with lowest common denominator :
   (i) $\frac{1}{18}, \frac{2}{9}, \frac{2}{3}, \frac{1}{6}$
   (ii) $\frac{1}{5}, \frac{2}{15}, \frac{1}{6}, \frac{3}{10}$
   (iii) $\frac{3}{65}, \frac{7}{26}, \frac{9}{10}, \frac{4}{5}$
   (iv) $\frac{1}{2}, \frac{8}{45}, \frac{7}{36}, \frac{7}{9}$

5. The L.C.M. of two numbers is 750 and their product is 7500. Find their H.C.F.

6. The H.C.F. and L.C.M. of two numbers are 14 and 280 respectively. If one of the number is 70, find the other.

7. The product of two numbers is 1628. If their H.C.F. is 1, determine their L.C.M.

8. Can two numbers have 12 as their H.C.F. and 260 as their L.C.M.? Give reasons in support of your answer.

   [**Hint** : H.C.F. of two numbers must be a factor of their L.C.M.]

3.6 Everyday Problems on H.C.F. and L.C.M.

We come across a number of situations which make use of the concepts of H.C.F. and L.C.M. Let us consider the following examples:

Example 9 : Find the largest number which divides 245 and 1029 leaving remainder 5 in each case.

Solution : The number divides 245 with the remainder 5, i.e., it must divide 245 − 5 (= 240) exactly. Similarly the number must divide 1029 − 5, i.e., 1024 exactly. The required largest number, therefore, must be the H.C.F. of 240 and 1024.

H.C.F. of 240 and 1024 is 16.
Therefore, the required number is 16.

Check : 245 ÷ 16 = 15, remainder 5
1029 ÷ 16 = 64, remainder 5

Example 10 : Two tankers contain 850 litres and 680 litres of petrol respectively. Find the maximum capacity of a container which can measure the petrol of either tanker an exact number of times.

Solution : The maximum capacity of the container which can measure 850 l and 680 l of petrol an exact number of times, must be the H.C.F. of 850 l and 680 l.

H.C.F. of 850 and 680 = 170

Hence the maximum capacity of the required container must be 170 l.

Example 11 : Find the smallest number which when divided by any of 42, 72 and 96 leaves the remainder 7.

Solution : The required number should be 7 more than the smallest common multiple of 42, 72 and 96.

L.C.M. of 42, 72 and 96 is 2016.

Therefore, the required number is 2016 + 7 = 2023.

Example 12 : Delhi to Meerut buses run every 40 minutes while from Meerut to Delhi, they run every 45 minutes. At what earliest time will two buses coming from opposite directions pass a particular bridge between Delhi and Meerut if they pass the same bridge at 11.15 a.m.

Solution : The earliest time, in minutes, should be the lowest common multiple of 40 minutes and 45 minutes added to 11.15 a.m.

L.C.M. of 40 minutes and 45 minutes is 360 minutes, i.e., 6 hours.
Therefore, the two buses will pass the same bridge 6 hours after 11.15 a.m. Hence, the two buses will pass the bridge at 5.15 p.m.

EXERCISE 3(iv)

1. Determine the smallest 3-digit number which is exactly divisible by 6, 8 and 12.
2. Determine the largest 3-digit number which is exactly divisible by 8, 10 and 12.
3. If 90, 146 and 230 are each divided by the same number, the remainder is 6. What is the greatest possible divisor?
4. Find the greatest number that will divide 478 and 719 leaving remainders 2 and 5 respectively.
5. Find the greatest number that will divide 398, 436 and 542 leaving remainders 7, 11 and 15 respectively.

* 6. Find the number nearest to 100000 that is exactly divisible by 2, 3, 4, 5, 6 and 7. [**Hint** : Find the multiple of the L.C.M. of 2, 3, 4, 5, 6 and 7 nearest to 100000.]

7. The length, breadth and height of a room are 8 m 25 cm, 6 m 75 cm and 4 m 50 cm respectively. Find the longest tape which can measure the three dimensions of the room exactly.

* 8. A rectangular courtyard is 20 m 16 cm long and 15 m 60 cm broad. It is to be paved with square stones of the same size. Find the smallest possible number of such stones.

9. What is the least length of a tape which can be cut up exactly into equal strips 65 cm long and also into equal strips 55 cm long?

10. Either by striding 75 cm or by 90 cm a man wants to take an exact number of steps to walk across a road. What must be the least width of such a road.

11. Lines are drawn so as to divide a rectangle 84 cm long and 64 cm broad into equal squares. Find the least possible number of squares.

12. The circumferences of the wheels of two different sized-bullock carts are 5 m 76 cm and 6 m 72 cm respectively. What is the least distance in which both make an exact number of turns?

13. Telegraph poles occur at equal distances of 220 m along a road and heaps of stones are put at equal distances of 500 m along the same road. The first heap is at the foot of the first pole. How far along the road is the next heap which lies at the foot of a pole?

14. Find the smallest number such that the remainder is 5 when it is divided either by 100 or by 120 or by 150.

15. Find the smallest weight which can be divided into an exact number of parcels weighing 54 kg, 42 kg, 28 kg or 15 kg.

*16. A boy saves 35 p daily. Find the least number of days in which he will be able to save an exact number of rupees. Also find his total savings during that period.

17. Three boys step off together from the same spot. Their steps measure 63 cm, 70 cm and 77 cm respectively. At what distance from the starting point will they again step together?

*18. Given that 1475 kilograms = 3245 pounds. What is the least number of kilograms equal to an exact number of pounds?

UNIT IV

FRACTIONAL NUMBERS

4.1 Multiplication of a Fractional Number by a Whole Number

We know how to multiply two whole numbers.

$3 \times 5 = 5 + 5 + 5 = 15$

The same process is used in multiplying a fractional number by a whole number. Let us study the following examples:

(i) $4 \times \frac{2}{3} = \frac{2}{3} + \frac{2}{3} + \frac{2}{3} + \frac{2}{3} = \frac{2+2+2+2}{3} = \frac{2 \times 4}{3}$

$= \frac{8}{3} = 2\frac{2}{3}$

We note : $4 \times \frac{2}{3} = \frac{4 \times 2}{3}$

(ii) $3 \times \frac{5}{6} = \frac{5}{6} + \frac{5}{6} + \frac{5}{6} = \frac{5+5+5}{6} = \frac{3 \times 5}{6}$

$= \frac{15}{6} = \frac{5}{2}$ (Why?) $= 2\frac{1}{2}$

We note : $3 \times \frac{5}{6} = \frac{3 \times 5}{6}$

We conclude:

The product of a whole number and a fraction is a fraction whose numerator is the product of the whole number and the numerator of the fraction, and whose denominator is the same as that of the fraction.

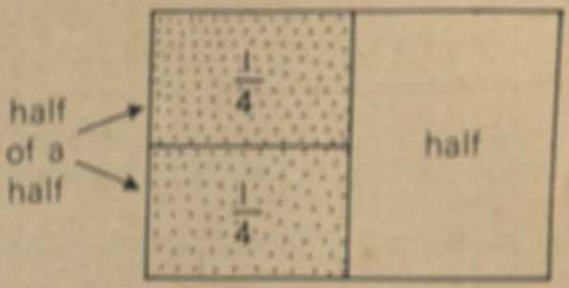
4.2 Multiplication of a Fractional Number by a Fractional Number

Geeta took a piece of ribbon. She cut it into halves. She put one-half in the box and shared the other half equally with her sister. What part of the whole ribbon did her sister get?

We want to find half of a half, i.e., $\frac{1}{2} \times \frac{1}{2}$. Let us observe the figure on the right.

We find that

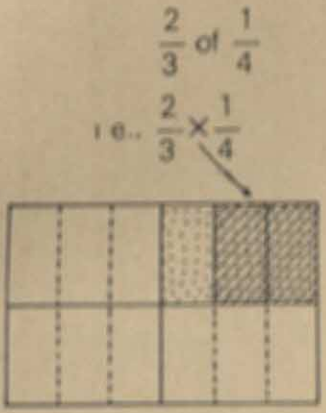
$$\frac{1}{2}\times\frac{1}{2}=\frac{1}{4}$$

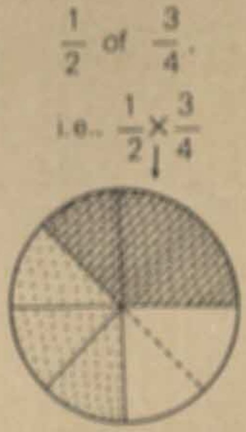


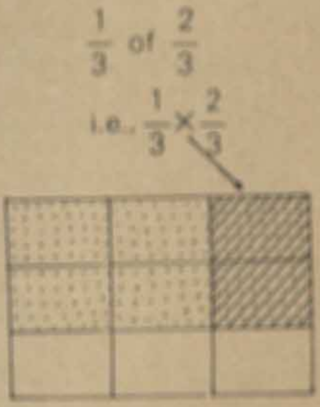
We note that

$$\frac{1}{2}\times\frac{1}{2}=\frac{1}{4}=\frac{1\times 1}{2\times 2}$$

Let us now study the following figures to observe the same fact:


$\frac{2}{3}$ of $\frac{1}{4}$
i.e., $\frac{2}{3}\times\frac{1}{4}$


$\frac{1}{2}$ of $\frac{3}{4}$,
i.e., $\frac{1}{2}\times\frac{3}{4}$


$\frac{1}{3}$ of $\frac{2}{3}$
i.e., $\frac{1}{3}\times\frac{2}{3}$

$$\frac{2}{3}\times\frac{1}{4}=\frac{2}{12} \qquad \frac{1}{2}\times\frac{3}{4}=\frac{3}{8} \qquad \frac{1}{3}\times\frac{2}{3}=\frac{2}{9}$$

$$\frac{2}{3}\times\frac{1}{4}=\frac{2\times 1}{3\times 4} \qquad \frac{1}{2}\times\frac{3}{4}=\frac{1\times 3}{2\times 4} \qquad \frac{1}{3}\times\frac{2}{3}=\frac{1\times 2}{3\times 3}$$

Thus, we find that **the product of two fractional numbers is a fractional number whose numerator is the product of the numerators of the given fractional numbers and whose denominator is the product of the denominators of the given fractional numbers.**

4.3 Multiplication of Fractions and Mixed Numbers

Let us study the following examples:

(i) $\frac{1}{3}\times 3\frac{1}{2}=\frac{1}{3}\times\frac{7}{2}=\frac{1\times 7}{3\times 2}=\frac{7}{6}=1\frac{1}{6}$

(ii) $5\frac{1}{3} \times 3\frac{3}{4} = \frac{16}{3} \times \frac{15}{4} = \frac{16 \times 15}{3 \times 4} = \frac{240}{12} = \frac{240 \div 12}{12 \div 12} = \frac{20}{1} = 20$

We note that **to multiply mixed numbers, we first convert them to the corresponding improper fractions and then find the product.**

4.4 Multiplication of More Than Two Fractional Numbers

Let us again study the following examples:

(i) $\frac{2}{3} \times \frac{4}{5} \times \frac{6}{7} = \left(\frac{2}{3} \times \frac{4}{5}\right) \times \frac{6}{7}$

$= \frac{8}{15} \times \frac{6}{7}$

$= \frac{48}{105}$

Note: $2 \times 4 \times 6 = 48$, $3 \times 5 \times 7 = 105$

(ii) $1\frac{3}{5} \times 2\frac{2}{3} \times \frac{4}{7} = \frac{8}{5} \times \frac{8}{3} \times \frac{4}{7}$

$= \left(\frac{8}{5} \times \frac{8}{3}\right) \times \frac{4}{7}$

$= \frac{64}{15} \times \frac{4}{7}$

$= \frac{256}{105}$

Note: $8 \times 8 \times 4 = 256$, $5 \times 3 \times 7 = 105$

The above process can be used to multiply more than three fractional numbers also.

Therefore, **the product of two or more fractions is a fraction whose numerator is the product of the numerators of the given fractions and whose denominator is the product of the denominators of the given fractions.**

4.5 Simplification of Fractions

We recall how we reduce fractions to lowest terms. We divide the numerator and the denominator by their H.C.F.

$\frac{20}{36} = \frac{20 \div 4}{36 \div 4}$ Think : $20 = 4 \times 5$ and $36 = 4 \times 9$

$= \frac{5}{9}$

We often use another shorter method. We factorize both the numerator and the denominator into primes and **cancel** all common prime factors.

Thus, $$\frac{20}{36}=\frac{\cancel{2}\times\cancel{2}\times 5}{\cancel{2}\times\cancel{2}\times 3\times 3}$$
$$=\frac{5}{9}$$

Let us now consider one more example:

$$\frac{24}{75}\times\frac{30}{96}=\frac{24\times 30}{75\times 96}=\frac{2\times 2\times 2\times 3\times 2\times 3\times 5}{3\times 5\times 5\times 2\times 2\times 2\times 2\times 2\times 3}$$
$$=\frac{\cancel{2}\times\cancel{2}\times\cancel{2}\times\cancel{2}\times\cancel{3}\times\cancel{3}\times\cancel{5}}{\cancel{2}\times\cancel{2}\times\cancel{2}\times\cancel{2}\times 2\times\cancel{3}\times\cancel{3}\times\cancel{5}\times 5}$$
$$=\frac{1}{2\times 5}$$
$$=\frac{1}{10}$$

The whole process is further simplified by using the method of cancelling directly as follows:

$$\frac{\overset{\cancel{2}}{\cancel{24}}}{\underset{5}{\cancel{75}}}\times\frac{\overset{\cancel{2}}{\cancel{30}}}{\underset{\underset{\underset{2}{\cancel{4}}}{\cancel{8}}}{\cancel{96}}}$$

Think:

$15\times 5=75$
$12\times 2=24$
$2\times 4=8$
$2\times 2=4$

$15\times 2=30$
$12\times 8=96$

$$=\frac{1}{5\times 2}$$
$$=\frac{1}{10}$$

A note to the teacher: The teacher must point out that, in cancelling, when no factor is left in either the numerator or the denominator, it is understood to be 1. (Why?)

4.6 Properties of Multiplication of Fractional Numbers

We have learnt some basic properties of multiplication of whole numbers. We can easily find out that the same properties also hold in case of fractional numbers.

(i) $\frac{3}{4} \times \frac{2}{5} = \frac{3 \times 2}{4 \times 5} = \frac{6}{20} = \frac{3}{10}$

$\frac{2}{5} \times \frac{3}{4} = \frac{2 \times 3}{5 \times 4} = \frac{6}{20} = \frac{3}{10}$

Therefore, $\frac{3}{4} \times \frac{2}{5} = \frac{2}{5} \times \frac{3}{4}$

Thus, **while multiplying fractions we may change their order, the product remains the same.**

(ii) $\left(\frac{5}{9} \times \frac{3}{5}\right) \times \frac{4}{7} = \left(\frac{5 \times 3}{9 \times 5}\right) \times \frac{4}{7} = \frac{1}{3} \times \frac{4}{7} = \frac{4}{21}$

$\frac{5}{9} \times \left(\frac{3}{5} \times \frac{4}{7}\right) = \frac{5}{9} \times \frac{12}{35} = \frac{4}{21}$

Therefore, $\left(\frac{5}{9} \times \frac{3}{5}\right) \times \frac{4}{7} = \frac{5}{9} \times \left(\frac{3}{5} \times \frac{4}{7}\right)$

Thus, **while multiplying more than two fractions, we may change their groupings, the product remains the same.**

(iii) $\frac{3}{4} \times 1 = \frac{3 \times 1}{4} = \frac{3}{4}$

$1 \times 1\frac{2}{3} = 1 \times \frac{5}{3} = \frac{1 \times 5}{3} = \frac{5}{3} = 1\frac{2}{3}$

Therefore, **the product of a fractional number and 1 is the number itself.**

(iv) $\frac{3}{4} \times 0 = \frac{3}{4} \times \frac{0}{1} = \frac{3 \times 0}{4 \times 1} = \frac{0}{4} = 0$

$0 \times 2\frac{2}{3} = \frac{0}{1} \times \frac{8}{3} = \frac{0 \times 8}{3} = \frac{0}{3} = 0$

Therefore, **the product of a fractional number and zero is zero.**

(v) $\frac{1}{2} \times \left(\frac{2}{3} + \frac{1}{4}\right) = \frac{1}{2} \times \left(\frac{8+3}{12}\right)$

$= \frac{1}{2} \times \frac{11}{12}$

$= \frac{11}{24}$

$\frac{1}{2} \times \frac{2}{3} + \frac{1}{2} \times \frac{1}{4} = \frac{1}{3} + \frac{1}{8}$

$= \frac{8+3}{24} = \frac{11}{24}$

Therefore, $\frac{1}{2}\times\left(\frac{2}{3}+\frac{1}{4}\right)=\frac{1}{2}\times\frac{2}{3}+\frac{1}{2}\times\frac{1}{4}$

In terms of three fractional numbers, this property can be stated as follows:

First × (second + third) = first × second + first × third

Similarly, we can verify that

First × (second − third) = first × second − first × third

Example 1 : Find the product

$$1\frac{13}{21}\times4\frac{1}{8}\times\frac{14}{17}$$

Solution :

$$1\frac{13}{21}\times4\frac{1}{8}\times\frac{14}{17}=\frac{\overset{\cancel{2}}{\cancel{34}}}{\underset{3}{\cancel{21}}}\times\frac{\overset{11}{\cancel{33}}}{\underset{\underset{2}{\cancel{4}}}{\cancel{8}}}\times\frac{\overset{\cancel{2}}{\cancel{14}}}{\cancel{17}}$$

$$=\frac{11}{2}$$

$$=5\frac{1}{2}$$

Example 2: Find the value of

$$1\frac{1}{2}-\frac{3}{1000}\times333\frac{1}{3}$$

Solution: We recall that we first perform the operation of multiplication.

$$1\frac{1}{2}-\frac{3}{1000}\times333\frac{1}{3}=\frac{3}{2}-\left(\frac{3}{1000}\times\frac{1000}{3}\right)$$

$$=\frac{3}{2}-1$$

$$=\frac{3-2}{2}$$

$$=\frac{1}{2}$$

Example 3: Simplify:

$$5\frac{2}{3}\times4\frac{5}{7}-5\frac{2}{3}\times3\frac{5}{7}$$

Solution :

$$
\begin{aligned}
5\frac{2}{3}\times 4\frac{5}{7}-5\frac{2}{3}\times 3\frac{5}{7} &= \frac{17}{3}\times\frac{33}{7}-\frac{17}{3}\times\frac{26}{7}\\
&=\frac{17}{3}\times\left(\frac{33}{7}-\frac{26}{7}\right)\\
&=\frac{17}{3}\times\frac{7}{7}\\
&=\frac{17}{3}\\
&=5\frac{2}{3}
\end{aligned}
$$

EXERCISE 4(i)

1. Find the product in simplest form:

(i) $7\times\frac{1}{3}$ (ii) $\frac{5}{6}\times 6$

(iii) $\frac{3}{4}\times 4$ (iv) $9\times\frac{7}{8}$

(v) $3\frac{1}{3}\times 3$ (vi) $14\times 4\frac{3}{4}$

(vii) $16\times 2\frac{1}{4}$ (viii) $1\frac{2}{3}\times 120$

(ix) $\frac{2}{3}\times\frac{1}{5}\times 1\frac{1}{3}$ (x) $2\frac{1}{8}\times 4\frac{3}{10}\times\frac{5}{17}$

(xi) $2\frac{1}{4}\times 3\frac{1}{5}\times 2\frac{5}{9}$ (xii) $100\times 3\frac{1}{10}\times 1\frac{9}{31}$

2. Fill in the blanks:

(i) $\frac{2}{3}\times 1\frac{1}{2}= \ldots \times\frac{2}{3}$ (ii) $12\frac{4}{7}\times 0 = \ldots$

(iii) $\ldots \times 5\frac{8}{9}=5\frac{8}{9}$ (iv) $6\times\frac{2}{5}\times\frac{3}{8}=6\times\ldots\times\frac{2}{5}$

(v) $4\frac{1}{2}\times\ldots\times 2\frac{7}{9}=0$ (vi) $\frac{11}{14}\times\frac{1}{8}\times 3=\frac{3}{8}\times\ldots$

(vii) $\frac{2}{5}\times\left(4+\frac{1}{2}\right)=\frac{2}{5}\times\ldots+\ldots\times\frac{1}{2}$

(viii) $\frac{5}{8}\times\left(\frac{2}{3}-\frac{1}{3}\right)=\ldots\times\frac{2}{3}-\ldots\times\frac{1}{3}$

(ix) $15\frac{3}{17}=\ldots+\frac{3}{17}$ (x) $6\times 2\frac{4}{5}=6\times 2+6\times\ldots$

(xi) $\frac{33}{8}=\ldots+\frac{1}{8}$ (xii) $1\frac{2}{3}\times\left(\frac{2}{7}\times\frac{6}{25}\right)=\left(1\frac{2}{3}\times\frac{2}{7}\right)\times\ldots$

3. State whether the following statements are true:

(i) $\frac{2}{7}\times\frac{3}{5}=\frac{2\times3}{7\times5}$

(ii) $2\frac{1}{5}\times\frac{7}{11}=\frac{2\times1\times7}{5\times11}$

(iii) $3\frac{1}{2}\times\frac{2}{7}=3+\frac{1\times2}{2\times7}$

(iv) $\frac{8}{9}+\frac{6}{7}=\frac{8+6}{9\times7}$

(v) $\frac{3}{4}\times\frac{2}{5}=\frac{3\times5+2\times4}{4\times5}$

(vi) $1\frac{1}{2}-\frac{3}{4}=1+\frac{1}{2}-\frac{3}{4}$

(vii) $4\frac{1}{2}\times\frac{3}{5}=4\times\frac{3}{5}+\frac{1}{2}\times\frac{3}{5}$

(viii) $\frac{1}{2}\times(4\frac{1}{3}-3\frac{1}{4})=\frac{1}{2}\times4\frac{1}{3}-\frac{1}{2}\times3\frac{1}{4}$

(ix) $211+\frac{1}{7}=\frac{212}{7}$

(x) $5\frac{1}{3}\times5\frac{1}{3}=25\frac{1}{9}$

(xi) $5-\frac{1}{4}\times\frac{1}{6}=(5-\frac{1}{4})\times\frac{1}{6}$

(xii) $172\times\frac{9}{37}=\frac{172\times9}{37}$

4. Find the value of

(i) $45+\frac{2}{5}\times2\frac{1}{2}$

(ii) $\frac{1}{5}\times2+\frac{1}{5}\times3$

(iii) $3\frac{1}{5}\times2\frac{1}{3}-\frac{11}{15}$

(iv) $2-\frac{1}{4}\times\frac{4}{7}$

(v) $(2-\frac{1}{4})\times\frac{4}{7}$

(vi) $3\frac{1}{5}\times4\frac{1}{3}-2\frac{1}{5}\times4\frac{1}{3}$

(vii) $\frac{1}{2}+\frac{1}{4}\times\frac{1}{4}\times\frac{1}{4}$

(viii) $4\frac{2}{3}+4\frac{2}{3}\times4\frac{2}{3}$

(ix) $2\frac{1}{5}\times2\frac{1}{5}-1\frac{1}{2}\times1\frac{1}{2}$

(x) $(4-\frac{999}{1000}-\frac{1}{1000})\times\frac{1}{4}$

(xi) $100+(\frac{1}{5}+\frac{4}{5})\times6$

(xii) $48\frac{2}{5}\times97\frac{1}{2}+48\frac{2}{5}\times2\frac{1}{2}$

5. Simplify:

(i) $4\frac{9}{15}\times3\frac{3}{4}\times\frac{1}{23}\times1\frac{1}{3}$

(ii) $14\frac{2}{3}+\frac{5}{9}\times\frac{3}{5}$

(iii) $66\frac{2}{3}\times\frac{1}{100}+\frac{2}{3}$

(iv) $\frac{14}{25}\times3\frac{1}{16}\times2\frac{1}{7}$

(v) $5\frac{11}{15}-5\times\frac{11}{15}$

(vi) $19\frac{1}{6}-19\frac{1}{6}\times\frac{1}{115}$

(vii) $16\frac{1}{5}\times\frac{1}{9}\times11\frac{2}{3}$

(viii) $15\frac{5}{6}\times1\frac{2}{19}\times\frac{3}{7}$

(ix) $(1-\frac{5}{6}\times1\frac{1}{5})\times46\frac{31}{40}$

(x) $\frac{17}{35}\times16\frac{1}{3}\times1\frac{8}{17}\times30$

(xi) $\frac{1}{3}+\frac{1}{3}\times\frac{1}{3}-\frac{1}{3}\times\frac{1}{3}\times\frac{1}{3}$

(xii) $56\frac{4}{7}\times24\frac{2}{5}-23\frac{2}{5}\times56\frac{4}{7}$

4.7 Reciprocal of a Fractional Number

We now consider some pairs of fractions whose numerators and denominators are interchanged and find their products:

Pairs of fractions	**Product**
$\frac{3}{4}$ and $\frac{4}{3}$	$\frac{3}{4} \times \frac{4}{3} = 1$
$\frac{2}{1}$ and $\frac{1}{2}$	$\frac{2}{1} \times \frac{1}{2} = 1$
$\frac{7}{8}$ and $\frac{8}{7}$	$\frac{7}{8} \times \frac{8}{7} = 1$

In each case the product is 1.

When the product of two fractional numbers is 1, we say that each of the numbers is the reciprocal of the other.

In the above examples,

(i) $\frac{3}{4}$ is the reciprocal of $\frac{4}{3}$ and $\frac{4}{3}$ is the reciprocal of $\frac{3}{4}$.

(ii) $\frac{2}{1}$ (i.e., 2) is the reciprocal of $\frac{1}{2}$ and $\frac{1}{2}$ is that of 2.

(iii) $\frac{7}{8}$ is the reciprocal of $\frac{8}{7}$ and $\frac{8}{7}$ is that of $\frac{7}{8}$.

It is clear from above that to get the reciprocal of a given number we write the fraction whose numerator and denominator are respectively the denominator and the numerator of the given fraction. If the number is a whole number, its denominator is considered to be 1.

Since the product of zero and any number is always zero, i.e., never equal to 1, we conclude:

The reciprocal of zero does not exist.

Also, $1 \times 1 = 1$

No other number multiplied to itself gives the product 1. Therefore, **1 is the only whole number whose reciprocal is the number itself.**

Let us now observe reciprocals of some numbers greater than 1 and of others less than 1.

Number greater than 1	**Reciprocal**
2	$\frac{1}{2}$
4	$\frac{1}{4}$
12	$\frac{1}{12}$

We note that each reciprocal is less than 1

Number between 0 and 1	**Reciprocal**
$\frac{1}{3}$	3
$\frac{2}{5}$	$\frac{5}{2}$, i.e., $2\frac{1}{2}$
$\frac{3}{8}$	$\frac{8}{3}$, i.e., $2\frac{2}{3}$

We note that each reciprocal is greater than 1. We, therefore, conclude:

If a number is

(i) **greater than 1, its reciprocal is less than 1;**
(ii) **1, its reciprocal is 1;**
(iii) **between 0 and 1, its reciprocal is greater than 1.**

Example 4: Find the reciprocal of

(i) $6\frac{1}{3}$ (ii) $10 + \frac{1}{2}$

Solution: (i) $6\frac{1}{3} = \frac{19}{3}$

Therefore, the required reciprocal is $\frac{3}{19}$

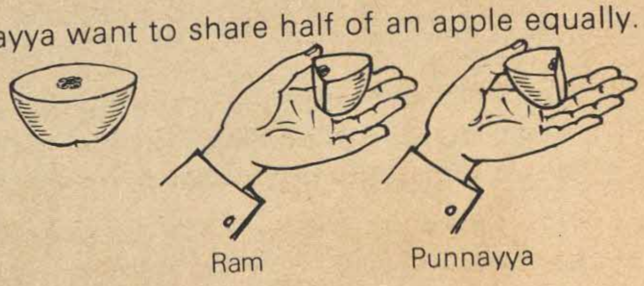
(ii) $10 + \frac{1}{2} = \frac{2 \times 10 + 1}{2} = \frac{21}{2}$

Therefore, the required reciprocal is $\frac{2}{21}$

4.8 Division of a Fractional Number by a Whole Number

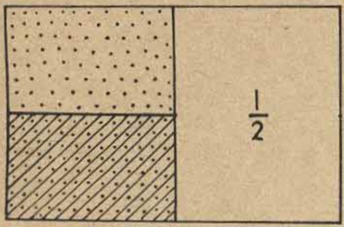
Let us suppose that Ram and Punnayya want to share half of an apple equally. What part of the apple does each get?

Obviously each of them gets one-fourth of the apple.



Thus, $\frac{1}{2} \div 2 = \frac{1}{4}$

Diagramatically



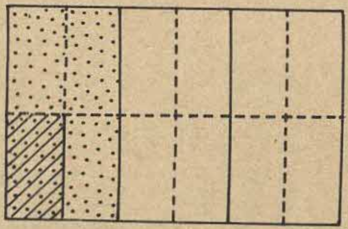
$$\frac{1}{2} \div 2 = \frac{1}{4}$$

We know that $\frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$

We note that $\frac{1}{2}$ is the reciprocal of 2.

Let us now divide $\frac{1}{3}$ by 4.

$\frac{1}{3} \div 4 \longrightarrow$



$$\frac{1}{3} \div 4 = \frac{1}{12}$$

We know that $\frac{1}{3} \times \frac{1}{4} = \frac{1}{12}$

We note that $\frac{1}{4}$ is the reciprocal of 4.

In view of the above we conclude:

To divide a fractional number by a whole number we multiply the fractional number by the reciprocal of the whole number (divisor).

Example 5: Divide $\frac{3}{25}$ by 9.

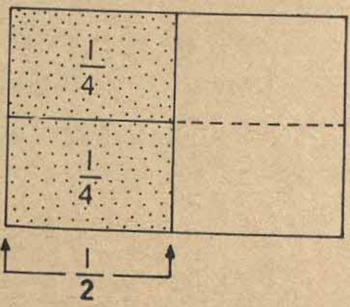
Solution:

$$\frac{3}{25} \div 9 = \frac{3}{25} \times \frac{1}{9} = \frac{1 \times 1}{25 \times 3} = \frac{1}{75}$$

4.9 Division of a Fractional Number by a Fractional Number

Let us divide $\frac{1}{2}$ by $\frac{1}{4}$. $\frac{1}{2} \div \frac{1}{4} = ?$

This in other words can be stated as 'How many fourths can be taken out of a half? or 'How many fourths together make a half?'



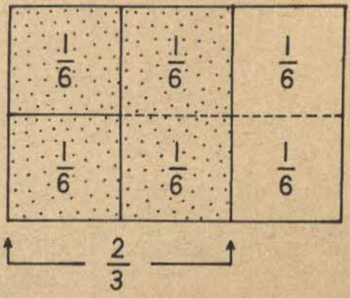
Let us look at the figure drawn on the right. The shaded part of the figure represents a half of the whole.

Thus, we find that 2 fourths make a half. Therefore,

$$\frac{1}{2} \div \frac{1}{4} = 2$$

We again note that $\frac{1}{2} \times \frac{4}{1} = 2$ and $\frac{4}{1}$ is the reciprocal of $\frac{1}{4}$ (divisor).

Similarly, to divide $\frac{2}{3}$ by $\frac{1}{6}$ we look at the figure on the right and find



$$\frac{2}{3} \div \frac{1}{6} = 4$$

We again note that $\frac{2}{3} \times \frac{6}{1} = 4$

and $\frac{6}{1}$ is the reciprocal of $\frac{1}{6}$. Therefore,

to divide a fractional number by a fractional number we multiply the dividend by the reciprocal of the divisor.

A note to the teacher: The teacher must point out that if the dividend or the divisor is a mixed number, it must be converted to the corresponding improper fraction before carrying out division process.

Example 6: Divide (i) 33 by $\frac{3}{5}$.

(ii) $5\frac{1}{7}$ by $1\frac{1}{14}$.

Solution: (i) $33 \div \frac{3}{5} = 33 \times \frac{5}{3}$

$$= 55$$

(ii) $5\frac{1}{7} \div 1\frac{1}{14} = \frac{36}{7} \div \frac{15}{14}$

$$= \frac{\cancel{36}^{12}}{\cancel{7}} \times \frac{\cancel{14}^{2}}{\cancel{15}_{5}}$$

$$= \frac{24}{5} = 4\frac{4}{5}$$

4.10 Properties of Division of Fractional Numbers

(i) We have

$$\frac{3}{5} \div 1 = \frac{3}{5} \times \frac{1}{1} = \frac{3}{5}$$

$$1\frac{2}{3} \div 1 = \frac{5}{3} \times \frac{1}{1} = \frac{5}{3} = 1\frac{2}{3}$$

$$4\frac{1}{5} \div 1 = \frac{21}{5} \times \frac{1}{1} = \frac{21}{5} = 4\frac{1}{5}$$

Therefore, we conclude:

When a fractional number is divided by 1, the quotient is the fractional number itself.

(ii) $\frac{3}{5} \div \frac{3}{5} = \frac{3}{5} \times \frac{5}{3} = 1$

$$1\frac{2}{3} \div 1\frac{2}{3} = \frac{5}{3} \div \frac{5}{3} = \frac{5}{3} \times \frac{3}{5} = 1$$

$$4\frac{1}{5} \div 4\frac{1}{5} = \frac{21}{5} \div \frac{21}{5} = \frac{21}{5} \times \frac{5}{21} = 1$$

Therefore, we conclude:

When a fractional number is divided by itself the quotient is 1.

(iii) $0 \div \frac{1}{2} = 0 \times \frac{2}{1} = \frac{0}{1} = 0$

$$0 \div 4\frac{1}{3} = 0 \div \frac{13}{3} = 0 \times \frac{3}{13} = \frac{0}{13} = 0$$

Hence, we conclude:

Zero divided by any fractional number (other than zero) gives the quotient zero.

(iv) Since division by zero is not defined, **we cannot divide a fractional number by zero.**

EXERCISE 4(ii)

1. Find the product and state whether one fractional number is the reciprocal of the other:

(i) $\frac{5}{8} \times \frac{8}{5}$ (ii) $14 \times \frac{3}{14}$

(iii) $\frac{5}{7} \times 1\frac{2}{5}$ (iv) $18\frac{1}{4} \times 4\frac{1}{2}$

(v) $3\frac{1}{2} \times \frac{2}{3}$ (vi) $100 \times \frac{1}{100}$

2. Fill in the blanks:

(i) $\ldots \times \frac{2}{3} = 1$ (ii) $2\frac{1}{3} \times \ldots = 1$

(iii) $1\frac{1}{4} \times \ldots = 1$ (iv) $1 = \frac{5}{17} \times \ldots$

(v) $\frac{3}{8} \div \ldots = 1$ (vi) $1\frac{5}{7} \div \ldots = 1\frac{5}{7}$

3. Find the reciprocal of

(i) 6 (ii) $\frac{1}{6}$ (iii) $\frac{2}{3}$

(iv) $\frac{3}{2}$ (v) 10 (vi) $1\frac{1}{10}$

(vii) $\frac{3}{11}$ (viii) $7\frac{1}{2}$ (ix) $9\frac{1}{3}$

(x) $1\frac{1}{4}$ (xi) $\frac{2}{25}$ (xii) $\frac{5}{31}$

4. Which number is the reciprocal of itself?

5. A fractional number is greater than 10. State whether its reciprocal is less than or greater than 10.

6. A fractional number lies between $\frac{1}{4}$ and $\frac{2}{3}$. State whether its reciprocal is less than or greater than 1.

7. Find the quotient :

(i) $\frac{2}{5} \div 2$ (ii) $\frac{4}{7} \div 8$ (iii) $1\frac{4}{5} \div 3$

(iv) $2\frac{1}{3} \div 7$ (v) $4\frac{2}{11} \div 23$ (vi) $5\frac{1}{10} \div 17$

(vii) $\frac{3}{4} \div \frac{5}{8}$ (viii) $\frac{5}{6} \div \frac{3}{4}$ (ix) $\frac{4}{7} \div \frac{4}{7}$

(x) $\frac{8}{15} \div \frac{4}{9}$ (xi) $\frac{4}{11} \div \frac{9}{22}$ (xii) $\frac{25}{36} \div \frac{5}{18}$

(xiii) $4\frac{2}{7} \div 2\frac{1}{7}$ (xiv) $2\frac{3}{7} \div \frac{14}{17}$ (xv) $3\frac{5}{8} \div 1\frac{5}{24}$

(xvi) $50 \div 3\frac{1}{3}$ (xvii) $100 \div 33\frac{1}{3}$ (xviii) $6\frac{5}{8} \div 3\frac{5}{16}$

(xix) $8\frac{2}{3} \div 5\frac{1}{4}$ (xx) $6\frac{4}{5} \div 5\frac{2}{3}$ (xxi) $66\frac{2}{3} \div 200$

4.11 Simplifications of Expressions Involving Fractional Numbers

When some fractional expressions involve more than one operation, we simplify them as we simplify whole number expressions. In the process, **we first perform the operation of division, next that of multiplication followed by those of addition and subtraction.** Let us consider the following examples which illustrate the process:

Example 7: Simplify : $\frac{4}{5} \div \frac{10}{15} \times \frac{8}{12}$

Solution:

$$\frac{4}{5} \div \frac{10}{15} \times \frac{8}{12} = \left(\frac{4}{5} \div \frac{10}{15}\right) \times \frac{8}{12}$$
$$= \left(\frac{4}{5} \times \frac{15}{10}\right) \times \frac{8}{12}$$
$$= \frac{6}{5} \times \frac{8}{12}$$
$$= \frac{4}{5}$$

Example 8 : Find the value of

$$100 - \frac{3}{4} \times 1\frac{2}{9} \div 3\frac{2}{3}$$

Solution :

$$100 - \frac{3}{4} \times 1\frac{2}{9} \div 3\frac{2}{3} = 100 - \frac{3}{4} \times \left(\frac{11}{9} \div \frac{11}{3}\right)$$
$$= 100 - \frac{3}{4} \times \left(\frac{11}{9} \times \frac{3}{11}\right)$$
$$= 100 - \frac{3}{4} \times \frac{1}{3}$$
$$= 100 - \frac{1}{4}$$
$$= 99\frac{3}{4}$$

EXERCISE 4(iii)

Simplify (1 to 12) :

1. $3\frac{1}{3} \div 1\frac{2}{3} \times \frac{1}{2}$
2. $2\frac{5}{6} \times \frac{3}{4} \div 4\frac{1}{4}$
3. $1\frac{2}{3} \times \frac{3}{25} \div 1\frac{2}{5}$
4. $10 + 11\frac{2}{3} \div 1\frac{1}{6}$
5. $1 + \frac{1}{4} \times 1\frac{1}{3} \div \frac{2}{3}$
6. $1\frac{3}{4} + \frac{3}{22} \div \frac{3}{11}$

7. $8\frac{2}{5} \div 4\frac{1}{5} - 1\frac{1}{4}$

8. $3\frac{1}{7} + 2\frac{5}{7} \times \frac{35}{95} - \frac{1}{2} \div 2$

9. $5\frac{3}{11} \times 1\frac{4}{29} - 11\frac{1}{4} \div 2\frac{1}{4}$

10. $\frac{5}{8} \times 13\frac{1}{3} - 4 \div \frac{1}{2}$

11. $200 + 1\frac{1}{2} \times \frac{2}{3} - \frac{6}{7} \div \frac{6}{7}$

12 $1 + \frac{7}{15} \times 1\frac{14}{31} \times 4\frac{3}{7} \div 3$

13. Divide $3\frac{1}{2}$ by the sum of 1 and $\frac{3}{4}$.

14. Divide the sum of 4 and $8\frac{1}{2}$ by 25.

15. Divide $14\frac{2}{7}$ by the product of $16\frac{2}{3}$ and $\frac{3}{7}$

16. Multiply $7\frac{1}{4}$ by the difference of $\frac{60}{87}$ and $\frac{2}{3}$

17. Divide the sum of $8\frac{2}{5}$ and $3\frac{3}{5}$ by the difference of $18\frac{2}{7}$ and $\frac{23}{7}$

18. Divide the sum of $7\frac{1}{2}$ and $2\frac{1}{4}$ by their difference.

4.12 Everyday Life Problems Involving Multiplication and Division of Fractional Numbers

In our day-to-day life we come across a number of situations wherein we make use of multiplication and division of fractions. Let us consider the following examples:

Example 9 : 1 metre of cloth costs Rs 15. Find the cost of $4\frac{1}{2}$ metres of the cloth.

Solution : Cost of $4\frac{1}{2}$ metres of cloth

$= \text{Rs } (15 \times 4\frac{1}{2})$

$= \text{Rs } (15 \times \frac{9}{2})$

$= \text{Rs } (\frac{135}{2})$

$= \text{Rs } 67.50$

Example 10 : Roopa distributed 5 kg of sweets among the students of Class V. If she gave each child $\frac{1}{8}$ kg of sweets, how many students were there in Class V?

Solution : Total number of students $= 5 \div \frac{1}{8}$

$= 5 \times \frac{8}{1}$

$= 40$

Example 11 : Find the area of a rectangular field whose length and breadth are $30\frac{1}{4}$ m and $16\frac{1}{2}$ m respectively.

Solution: Area of the field = Length × Breadth

$$= 30\frac{1}{4} \times 16\frac{1}{2} \text{ sq. m}$$

$$= \frac{121}{4} \times \frac{33}{2} \text{ sq. m}$$

$$= \frac{3993}{8} \text{ sq. m}$$

$$= 499\frac{1}{8} \text{ sq. m}$$

Example 12 : Ramesh, Suresh, Naresh, Dinesh and Satish give a party. Satish pays $\frac{1}{2}$ of the bill and the rest is shared equally by all others. What fraction of the bill does Ramesh pay?

Solution: If the bill is supposed to be 1, Satish pays $\frac{1}{2}$ Remaining bill

$1 - \frac{1}{2} = \frac{1}{2}$ is to be shared equally by 4 persons.

Therefore, the share of Ramesh

$$= \frac{1}{2} \div 4$$

$$= \frac{1}{2} \times \frac{1}{4}$$

$$= \frac{1}{8}$$

i.e., Ramesh will pay $\frac{1}{8}$ of the whole bill.

EXERCISE 4(iv)

1. $2\frac{2}{5}$ metres of cloth is required for making one shirt. How much cloth (in metres) should a person buy for making 4 such shirts?
2. The daily consumption of milk of a family is $2\frac{3}{4}$ litres. Determine the quantity (in litres) of milk consumed by the family in February, 1982.
3. Poonam bought $9\frac{3}{5}$ metres of khadi cloth at the rate of Rs 5 per metre. How much money is Poonam required to pay?

4. An aeroplane, on an average, covers 1800 km of distance in an hour. How much distance will it cover in $2\frac{5}{6}$ hours?
5. The product of two numbers is $19\frac{1}{2}$. If one of them is $3\frac{3}{8}$, determine the other.
6. $1\frac{1}{4}$ metres of cloth is required to prepare one banian. How much cloth, in metres, is required to prepare 3 dozen banians of the same size?
7. Find the area of a rectangular carpet $3\frac{1}{4}$ metres long and $2\frac{1}{5}$ metres wide.
8. How many half-litre bottles can be filled from a can containing $31\frac{1}{2}$ litres of milk?
9. In $6\frac{2}{5}$ hours a car covers a distance of 416 kilometres. Determine the average speed of the car per hour.
10. The area of a rectangular plot of land is $132\frac{1}{2}$ square metres. Find the length of the plot if its breadth is $10\frac{3}{5}$ metres.
11. One-third population of a village is illiterate. If the number of illiterates is 1106, find the number of literates and the total population of the village.
12. One-fourth population of a town is illiterate. If the number of literates is 60000, determine the number of illiterates and the total population of the town.
13. A drum is $\frac{3}{5}$ full. If 180 litres are required to fill it up, determine the capacity of the drum. [**Hint**: $\frac{2}{5}$ of the whole capacity equals 180 litres.]

*14. How many pieces of length $5\frac{2}{5}$ metres can be cut from a roll of wire of length 100 metres? How much wire remains?

*15. How many tins of ghee each holding $16\frac{1}{2}$ kilograms can be filled from a storage tank of capacity 1ton? How much of ghee will be left in the tank?

16. Two-third of a tank can be filled in $17\frac{1}{3}$ minutes. How many minutes will it require to fill the whole tank?

UNIT V

DECIMALS

5.1 Review

Fractions, like $\frac{1}{10}, \frac{2}{10}, \frac{11}{100}, \frac{15}{1000}$ whose denominators are 10, 100, 1000, etc. are called **decimal fractions**. We also express them as 0.1, 0.2, 0.11, 0.015 by using a point (.) called **decimal point** and call them **decimals.**

A decimal numeral consists of two parts:

(i) Whole number part
(ii) Decimal part

12.45
Whole number part ↗ ↑ ↖ Decimal part
Decimal point

The whole number part is on the left of the decimal point and the decimal part is on the right of the decimal point.

If a decimal numeral does not contain whole number part, we indicate it by writing a zero on the left of the decimal point as in 0.1, 0.2, etc. given above. However, sometimes we leave it blank as in .5, .275, etc.

A decimal numeral which does not contain decimal part, i.e., whose decimal part is zero, expresses a whole number. We may, therefore, express each whole number as a decimal numeral by writing a zero or zeros in its decimal part. Thus,

$8 = 8.0 = 8.00 = 8.000$, etc.
$160 = 160.0 = 160.00 = 160.000$, etc.

We know that in any decimal numeral the digits follow the place-value principle, i.e., any digit in a numeral becomes 10 times in value as it moves one place to its left and becomes one tenth in value as it moves one place to its right. Starting from the decimal point, the successive places from the right to the left (in the whole number part) are ones, tens, hundreds, thousands, etc. and from the left to the right (in the decimal part) are tenths, hundredths', thousandths', etc. The place-value chart looks as follows:

Thousands	Hundreds	Tens	Ones	Decimal point	Tenths	Hundredths	Thousandths
1000	100	10	1		$\frac{1}{10}$	$\frac{1}{100}$	$\frac{1}{1000}$

Let us consider the decimal numeral 3072.658. The place value of the digits are as follows:

Digit	**Place Value**
3	3×1000, i.e., 3000
0	0×100, i.e., 0
7	7×10, i.e., 70
2	2×1, i.e., 2
6	$6\times\frac{1}{10}$, i.e., $\frac{6}{10}$
5	$5\times\frac{1}{100}$, i.e., $\frac{5}{100}$
8	$8\times\frac{1}{1000}$, i.e., $\frac{8}{1000}$

It can be expressed in expanded form as follows:

$$3072.658 = 3\times1000+7\times10+2\times1+6\times\frac{1}{10}+5\times\frac{1}{100}+8\times\frac{1}{1000}$$

$$=3000+70+2+\frac{6}{10}+\frac{5}{100}+\frac{8}{1000}$$

We also note that inserting or deleting zeros on the right of the last significant (non-zero) digit in the decimal part of a numeral does not change its value. For example,

7.3= 7.30 = 7.300 = 7.3000

However, 6.3 and 6.03 are different. (Why?)

We also learnt in Class IV how to add and subtract decimals. We perform addition and subtraction in decimals just as we do in whole numbers keeping decimal points in one vertical column and arranging the digits of the numbers in proper places.

EXERCISE 5(i)

1. Write each of the following decimals in words:
   (i) 24.27 (ii) 302.087 (iii) 2700.109
2. Write each of the following in figures:
   (i) Thirty-seven hundredths

(ii) Thirty-seven thousandths
(iii) One thousand forty and five thousandths

3. Write the corresponding decimal numeral:

	Hundreds	Tens	Ones	Tenths	Hundredths	Thousandths
(i)		3	5	8		
(ii)	7	9	8	5	2	
(iii)		6	3	4	1	8

4. Write in expanded notation:
(i) 70835.01 (ii) 631.987 (iii) 1205.009
(iv) 0.27 (v) 0.863 (vi) 0.096

5. Rewrite in ascending order:
(i) 0.53, 4.32, 3.05, 3.65, 4.23, 5.03
(ii) 0.99, 9.09, 0.90, 0.009, 9.009
(iii) 0.01, 1.01, 0.10, 0.001, 1.001

6. Add together:
(i) 28.05 7.13, 3.614, 2.53, 15.02, 35.2
(ii) 4.57, 5.039, 0.018, 7.047, 9.003
(iii) 0.171, 5.024, 25.19, 7.05, 46.09
(iv) 1.02, 1.052, 0.038, 3.018, 1.108
(v) 73.05, 27.008, 5.07, 2.301, 1.9
(vi) 9.25 2.84, 19.03, 9.07, 1.003

7. Subtract the smaller number from the larger:
(i) 20.4, 21.98 (ii) 100.3, 100.03
(iii) 1.01, 1.10 (iv) 1.003, 9.07
(v) 50.03, 43.002 (vi) 444.44, 44.444

8. Subtract the difference of 602.67 and 498.213 from their sum.
9. Subtract the sum of 0.78 and 0.789 from 2.
10. Add the difference of 500.06 and 284.328 to their sum.

5.2 To Convert Decimals into Common Fractions

$$\text{(i) } 0.27 = \frac{2}{10} + \frac{7}{100} = \frac{2\times10+7}{100} = \frac{27}{100}$$

We note that the numerator is 27 (i.e., the given numeral without the decimal point) and the denominator contains as many zeros on the right of 1 as there are digits in the decimal part of the given numeral.

$$\text{(ii) } 2.678 = 2 + \frac{6}{10} + \frac{7}{100} + \frac{8}{1000} = \frac{2\times1000+6\times100+7\times10+8}{1000} = \frac{2678}{1000}$$

We again note that the numerator is 2678 (i.e., the given numeral without decimal point) and the denominator contains three zeros on the right of 1 as there are three digits in the decimal part of the given numeral.

(iii) $15.007 = 1\times10+5+\frac{7}{1000} = \frac{10\times1000+5\times1000+7}{1000} = \frac{15007}{1000}$

We again observe the same fact. Therefore, we conclude:

To convert a decimal into a common fraction we put the decimal numeral without the decimal point as the numerator and for the denominator we insert as many zeros on the right of 1 as there are digits in the decimal part of the given decimal numeral.

Example 1: Convert 242.625 into the common fraction in the lowest terms.

Solution:

$$242.625 = \frac{242625}{1000} \quad \text{(Why?)}$$

$$= \frac{1941}{8}$$

$$= 242\frac{5}{8}$$

Alternatively,

$$242.625 = 242 + 625$$

$$= 242 + \frac{625}{1000}$$

$$= 242 + \frac{5}{8}$$

$$= 242\frac{5}{8}$$

5.3 To Convert Common Fractions into Decimals

We have already learnt to convert a fraction into the equivalent fraction having a given denominator. We shall use the same method to convert fractions into equivalent fractions having denominators 10, 100, 1000, etc.

(i) $\frac{1}{2} = \frac{1}{2}\times\frac{10}{10} = \frac{5}{10} = .5$

(ii) $\frac{1}{4} = \frac{1}{4}\times\frac{10}{10}\times\frac{10}{10} = .25$

(iii) $\frac{1}{8} = \frac{1}{8}\times\frac{10}{10}\times\frac{10}{10}\times\frac{10}{10} = \frac{125}{1000} = .125$

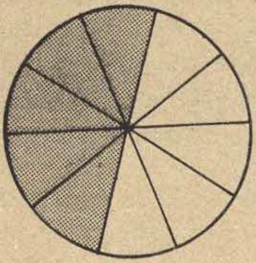
(iv) $\frac{3}{4} = \frac{3}{4}\times\frac{100}{100} = \frac{75}{100} = .75$

(v) $\frac{5}{8} = \frac{5}{8}\times\frac{1000}{1000} = \frac{625}{1000} = .625$

A note to the teacher: The teacher may explain the rationale of the above process of converting common fractions into decimals as follows.

(i) $\frac{1}{2}=\frac{1}{2}\text{ of }(\ 1\ )=\frac{1}{2}\text{ of }\left(\frac{10}{10}\right)=\frac{10}{2}\text{ of }\left(\frac{1}{10}\right)=5\times\left(\frac{1}{10}\right)=\frac{5}{10}=.5$

Pictorially,



$\frac{1}{2}=.5=5$ tenths

(ii) $\frac{1}{4}=\frac{1}{4}\text{ of }(\ 1\ )=\frac{1}{4}\text{ of }\left(\frac{100}{100}\right)=\frac{100}{4}\text{ of }\left(\frac{1}{100}\right)=25\times\frac{1}{100}=\frac{25}{100}=.25$

and so on.

What have we done? In (i) we divided 1 × 10 by 2, in (ii) 1 × 100 by 4, in (iii) 1 × 1000 by 8, in (iv) 3 × 100 by 4 and in (v) 5 × 1000 by 8. To convert the given fractions into decimals we could proceed as follows:

(i)
$$\begin{array}{r} .5 \\ 2\overline{)1.0} \\ \underline{10} \\ \underline{0} \end{array}$$

(ii)
$$\begin{array}{r} .25 \\ 4\overline{)1.00} \\ \underline{8} \\ 20 \\ \underline{20} \\ \underline{0} \end{array}$$

(iii)
$$\begin{array}{r} .125 \\ 8\overline{)1.000} \\ \underline{8} \\ 20 \\ \underline{16} \\ 40 \\ \underline{40} \\ \underline{0} \end{array}$$

$\frac{1}{2}=.5$ $\frac{1}{4}=.25$ $\frac{1}{8}=.125$

(iv)
$$\begin{array}{r} .75 \\ 4\overline{)3.00} \\ \underline{28} \\ 20 \\ \underline{20} \\ \underline{0} \end{array}$$

$\frac{3}{4}=.75$

(v)
$$\begin{array}{r} .625 \\ 8\overline{)5.000} \\ \underline{48} \\ 20 \\ \underline{16} \\ 40 \\ \underline{40} \\ \underline{0} \end{array}$$

$\frac{5}{8}=.625$

We note that in each case we have divided the number (obtained by inserting as many zeros on the right of the numerator of the given fraction as we require) by the denominator considering as if there are no decimal points. The decimal points have been inserted only to locate the places of the decimal points in the quotients.

In view of the above, we take the following steps to convert a common fraction into decimal :

Step 1 : We divide the numerator of the given fraction by its denominator.

Step 2 : When we have finished the division process and a remainder (other than zero) is left, we insert a decimal point in the quotient and insert as many zeros on the right of the dividend as are required for Step 3.

Step 3 : We continue the process of division just like whole numbers, till the last remainder is zero.

> **A note to the teacher** : The teacher may point out that conversion of some fractions like $\frac{1}{3}, \frac{2}{7}, \frac{6}{11}$ for which the process of division never ends is beyond the scope of this book.

Example 2 :Convert $2\frac{7}{8}$ into decimal.

Solution : First Method: $2\frac{7}{8} = \frac{23}{8}$

Since $\frac{23}{8} = 2.875$

Therefore, $2\frac{7}{8} = 2.875$

$$
\begin{array}{rr}
 & 2.875 \\ \cline{2-2}
8\,) & 23.000 \\
 & 16 \\ \cline{2-2}
 & 70 \\
 & 64 \\ \cline{2-2}
 & 60 \\
 & 56 \\ \cline{2-2}
 & 40 \\
 & 40 \\ \cline{2-2}
 & 0
\end{array}
$$

Second Method : $2\frac{7}{8} = 2 + \frac{7}{8}$

Since $\frac{7}{8} = .875$

Therefore, $2\frac{7}{8} = 2.875$

$$
\begin{array}{rr}
 & .875 \\ \cline{2-2}
8\,) & 7.000 \\
 & 64 \\ \cline{2-2}
 & 60 \\
 & 56 \\ \cline{2-2}
 & 40 \\
 & 40 \\ \cline{2-2}
 & 0
\end{array}
$$

EXERCISE 5(ii)

1. Express each of the following decimals into expanded form:

(i) .63 (ii) 0.758 (iii) 1.2
(iv) 67.068 (v) 790.009 (vi) 1000.1

2. Convert each of the following decimals into common fraction or mixed number in the lowest form:

(i) 0.25 (ii) 0.64 (iii) 0.245
(iv) 1.2 (v) 2.5 (vi) 3.60
(vii) 70.8 (viii) 77.7 (ix) 44.44
(x) 4.444 (xi) 0.999 (xii) 999.09

3. Convert each of the following fractions or mixed numbers into decimal

(i) $\frac{1}{6}$ (ii) $\frac{2}{5}$ (iii) $\frac{3}{8}$
(iv) $1\frac{1}{2}$ (v) $2\frac{1}{4}$ (vi) $\frac{21}{4}$
(vii) $\frac{81}{5}$ (viii) $\frac{2}{25}$ (ix) $3\frac{8}{25}$
(x) $4\frac{1}{20}$ (xi) $6\frac{13}{40}$ (xii) $7\frac{7}{50}$
(xiii) $\frac{1}{125}$ (xiv) $3\frac{63}{125}$ (xv) $40\frac{39}{40}$

5.4 Multiplication of a Decimal by a Natural Number

Let us consider some multiplication facts in which a decimal is multiplied by a natural number.

(i) $0.2 \times 4 = 0.2 + 0.2 + 0.2 + 0.2 = 0.8$ (Why?)
We note that $2 \times 4 = 8$

(ii) $1.56 \times 3 = 1.56 + 1.56 + 1.56$
$= 4.68$
We note that $156 \times 3 = 468$

(iii) $3.85 \times 5 = 3.85 + 3.85 + 3.85 + 3.85 + 3.85$
$= 19.25$
We note that $385 \times 5 = 1925$

In each of the above cases we observe that the product contains as many decimal places as the multiplicand itself.
Therefore

To multiply a decimal by a natural number, we perform the multiplication as if we are

multiplying natural numbers, except that in the product we mark off a decimal point to give us as many decimal places in the product as there are in the multiplicand.

Example 3 : Multiply 6.58 by 16.

Solution:

$$\begin{array}{r} 658 \\ \times\ 16 \\ \hline 3948 \\ 658 \\ \hline 10528 \\ \hline \end{array}$$

Since, 6.58 contains two decimal places. Therefore, the product must contain two decimal places.

Hence, 6.58 × 16 = 105.28

5.5 Multiplication of a Decimal by 10, 100, 1000, etc.

Let us consider the following products :

(i) 2.35 × 10 = 23.50

= 23.5

$$\begin{array}{r} 235 \\ \times\ 10 \\ \hline 2350 \\ \hline \end{array}$$

(ii) 16.084 ×100 = 1608. 4 since 16084 × 100 = 1608400

(iii) 25.678 × 10 = 256.78 (Verify.)

In each of the above cases if we carefully look at the multiplicand and the product, we find that in case of multiplication by 10, the product is obtained by moving the decimal point of the multiplicand one place to the right, and in case of multiplication by 100, it is obtained by moving the decimal point two places to the right.

> **A note to the teacher** : The teacher must help the students to observe the same fact by means of some more examples. He must ensure that students realise that to multiply a decimal by 10, 100, 1000, etc, the product is obtained by moving the decimal point of the multiplicand as many places to the right as there are zeros in the multiplier.

In view of the above we conclude :

To multiply a decimal by 10, 100, 1000, etc. we get the product by moving the decimal point of the multiplicand as many places to the right as there are zeros in the multiplier.

Example 4 : Multiply 203.005 by 1000.

Solution : Since there are three zeros in the multiplier (1000), to get the product we simply move the decimal point of 203.005 three places to the right. Thus,

$$\begin{aligned} 203.005 \times 1000 &= 203005.0 \qquad \text{(Why?)} \\ &= 203005 \end{aligned}$$

A note to the teacher : The teacher must point out that the product of a decimal and zero is zero. Thus,

$0.2 \times 0 = 0 \quad 2.367 \times 0 = 0 \quad 44.809 \times 0 = 0$

5.6 Multiplication of a Decimal by a Decimal

Let us concentrate on the following products:

$$\begin{aligned} \text{(i)} \quad .2 \times .3 &= \frac{2}{10} \times \frac{3}{10} \\ &= \frac{6}{100} \\ &= .06 \qquad \text{[We note that } 2 \times 3 = 6.] \end{aligned}$$

$$\begin{aligned} \text{(ii)} \quad 2.3 \times 0.12 &= \frac{23}{10} \times \frac{12}{100} \\ &= \frac{276}{1000} \\ &= 0.276 \qquad \text{[We note that } 23 \times 12 = 276.] \end{aligned}$$

$$\begin{aligned} \text{(iii)} \quad 1.25 \times 2.1 &= \frac{125}{100} \times \frac{21}{10} \\ &= \frac{125 \times 21}{1000} \\ &= \frac{2625}{1000} \\ &= 2.625 \qquad \text{[We again note that } 125 \times 21 = 2625.] \end{aligned}$$

In each of the above cases we find that the product contains as many decimal places as there are in the multiplicand and the multiplier together. We conclude:

To multiply a decimal by a decimal, we perform the multiplication as if we are multiplying whole numbers except that in the product we mark off a decimal point to give us as many decimal places in the product as there are in the multiplicand and the multiplier together.

Example 5 : Find the product of 14.25 and 6.4.

Solution : 14.25 × 6.4 = 91.200
= 91.2

$$\begin{array}{r} 1425 \\ \times\ 64 \\ \hline 5700 \\ 8550 \\ \hline 91200 \\ \hline \end{array}$$

Example 6: Fill in the blanks to make each of the following statements true:

(i) 7.534 × ... = 753.4
(ii) 12.7 × 8.4 = ... × 84

Solution : (i) Comparing the multiplicand and the product we find that in the product decimal point is moved two places to the right. Therefore, the multiplier should be 100, i.e., the blank should be filled in by 100.

(ii) We know that the product should contain as many decimal places as the multiplicand and the multiplier together contain. Therefore, the blank should be filled in by 1.27.

EXERCISE 5(iii)

1. Multiply

(i) 4.623 by 5
(ii) 18.116 by 6
(iii) 28.395 by 12
(iv) 35.08 by 18
(v) 2.768 by 45
(vi) 3.027 by 63
(vii) 9.385 by 76
(viii) 7.182 by 75
(ix) 21.371 by 121
(x) 0.004 by 135
(xi) 0.005 by 144
(xii) 1.012 by 244

2. Find the Product:

(i) 0.4 × 10
(ii) 0.04 × 10
(iii) 0.004 × 10
(iv) 0.29 × 10
(v) 2.9 × 10
(vi) 0.029 × 10
(vii) 0.323 × 100
(viii) 5.606 × 1000
(ix) 3.280 × 1000
(x) 76.5 × 100
(xi) 8972.4 × 1000
(xii) 69.08 × 1000

3. Multiply 6.425 by 8. Write down the product orally when 6.425 is multiplied by

(i) 80
(ii) 800
(iii) 8000
(iv) 0.8
(v) 0.80
(vi) 0.08

[**Hint**: The product will contain as many decimal places as the multiplicand and multiplier together contain.]

4. Determine the value of

(i) 1.2 × 1.2
(ii) 2.4 × 2.5
(iii) 36.52 × 3.8
(iv) 43.05 × 4.2

(v) 0.34 × 17.3
(vi) 4.008 × 0.0
(vii) 1.1 × 1.11
(viii) 6.55 × 0.5 × 16
(ix) 0.7 × 0.07 × 7
(x) 15 × 1.5 × 1.50
(xi) 4.01 × 0.1 × 400
(xii) 4 × 0.02 × 0.4 × 1000

5. Fill in the blanks so that each of the following statements is true :

(i) 3.65 = ...× 0.365
(ii) 2.73 × ... = 273
(iii) 2.73 × ... = 2730
(iv) 1000 × ... = 6432
(v) 6.5 = ... × 0.65
(vi) 24 × 0.008 = ... × 0.8
(vii) 1.1 × 0.1 = 0.011 × ...
(viii) 10 × 5.8 × 2.4 = ... 24
(ix) 0.245 × ... = 24.5 × 7.2
(x) 0.27 × 0.83 = ... × 8.3
(xi) 2.47 × ... = 0.93 × 2470
(xii) 458 × 0.032 = ... × 3.2

6. Verify that each of the following statements is true:

(i) 3.4 × 6.7 = 6.7 × 3.4
(ii) 2.597 × 1 = 2.597
(iii) 56 × 0.23 = 0.23 × 56
(iv) 1 × 14.77 = 14.77
(v) 2.3 × 2.4 × 2.5 = 2.5 × 2.4 × 2.3
(vi) 23 × 24 = 2.3 × 2.4 × 100
(vii) 6.008 × 10 = 60.08
(viii) 100 × 751.625 = 10 × 7516.25

5.7 Division of a Decimal by a Natural Number

Let us concentrate on the following examples:

(i) 24 hundredths ÷ 6 = (24 ÷ 6) hundredths
= 4 hundredths

Therefore, .24 ÷ 6 = .04

$$\begin{array}{r} .04 \\ 6\overline{).24} \\ 24 \\ \hline 0 \\ \hline \end{array}$$

(ii) 84 tenths ÷ 14 = (84 ÷ 14) tenths
= 6 tenths

Therefore, 8.4 ÷ 14 = .6

$$\begin{array}{r} .6 \\ 14\overline{)8.4} \\ 84 \\ \hline 0 \\ \hline \end{array}$$

(iii) 35 thousandths ÷ 5 = 7 thousandths

Therefore, 0.035 ÷ 5 = 0.007

$$\begin{array}{r} .007 \\ 5\overline{).035} \\ 35 \\ \hline 0 \end{array}$$

(iv) 12 tenths ÷ 8 = 1 tenth, remainder 4 tenths

Obviously 8 does not exactly divide 12 tenths in tenths. We, therefore, convert tenths into hundredths and see whether 8 divides it in hundredths.

12 tenths = 120 hundredths

120 hundredths ÷ 8 = 15 hundredths

Therefore, 1.2 ÷ 8 = .15

$$\begin{array}{r} .15 \\ 8\overline{)1.20} \\ 8 \\ \hline 40 \\ 40 \\ \hline 0 \\ \hline \end{array}$$

(v) 18 tenths ÷ 8 = 2 tenths, remainder 2 tenths

Since 8 does not exactly divide 18 tenths in tenths, we convert 18 tenths into hundredths.

18 tenths = 180 hundredths

180 hundredths ÷ 8 = 22 hundredths, remainder 4 hundredths

Since 8 does not exactly divide 18 tenths in hundredths also we, therefore, convert 18 tenths into thousandths.

18 tenths = 1800 thousandths

1800 thousandths ÷ 8 = 225 thousandths

Therefore, 18 tenths ÷ 8 = 225 thousandths

or, 1.8 ÷ 8 = .225

$$\begin{array}{r} .225 \\ 8\overline{)1.800} \\ 16 \\ \hline 20 \\ 16 \\ \hline 40 \\ 40 \\ \hline 0 \\ \hline \end{array}$$

In view of the above, to divide a decimal by a natural number we take the following steps:

Step 1 : **We take the process of division as in case of whole numbers ignoring the decimal point.**

Step 2 : In the process we first divide the whole number part of the dividend. When we have finished, we mark a decimal point in the quotient and proceed to divide the decimal part.

Note 1: If the whole number part of a dividend is zero, we start by marking a decimal point in the quotient and on the right of the decimal part insert a zero for each digit of the dividend till they together make a number greater than the divisor.

Note 2 : If the whole number part of a dividend is less than the divisor, we again start by marking a decimal point in the quotient. On the right of this decimal point put a zero if the number formed by the whole number part and the first digit of the decimal part is less than the divisor; put two zeros if the number formed by the whole number part and the first two digits of the decimal part is still less than the divisor; and so on.

Step 3 : If the last remainder is other than zero, we insert as many zeros on the right of the dividend as are necessary to make zero as the last remainder in the process of division.

The following examples will further illustrate the process :

Example 7 : Divide 121.082 by 26.

Solution :

$$
\begin{array}{r}
4.657 \\
26\,\overline{)121.082} \\
\underline{104} \\
170 \\
\underline{156} \\
148 \\
\underline{130} \\
182 \\
\underline{182} \\
\underline{0}
\end{array}
$$

Therefore, $121.082 \div 26 = 4.657$

Example 8 : Divide 1.008 by 36.

Solution :

$$
\begin{array}{r}
.028 \\
36\,\overline{)\;1.008} \\
\underline{72} \\
288 \\
\underline{288} \\
\underline{0}
\end{array}
$$

Therefore, $1.008 \div 36 = 0.028$

Example 9 : Find the quotient $0.169 \div 13$.

Solution :

$$\begin{array}{r} .013 \\ 13\overline{)\;0.169} \\ 13 \\ \hline 39 \\ 39 \\ \hline 0 \\ \hline \end{array}$$

Therefore, $0.169 \div 13 = 0.013$

5.8 Division of a Decimal by a Decimal

We know that if both the numerator and the denominator are multiplied by the same non-zero number an equivalent fraction is obtained. In view of this let us consider the following divisions :

(i)
$$\begin{aligned} 1.28 \div 0.8 &= \frac{1.28}{0.8} \\ &= \frac{1.28 \times 10}{0.8 \times 10} \\ &= \frac{12.8}{8} \qquad \text{(Why?)} \end{aligned}$$

Thus, $1.28 \div 0.8 = 12.8 \div 8$

(ii)
$$\begin{aligned} 15.625 \div 1.25 &= \frac{15.625}{1.25} \\ &= \frac{15.625 \times 100}{1.25 \times 100} \\ &= \frac{1562.5}{125} \end{aligned}$$

Therefore, $15.625 \div 1.25 = 1562.5 \div 125$

In each of the above we have converted the divisor into a natural number by suitably multiplying the given dividend and the divisor by 10 or 100 or 1000, etc.

Therefore,

To divide a decimal by a decimal we multiply both the dividend and the divisor by 10 or 100 or 1000, etc. so that the divisor is a natural number and then divide as in case of a natural number divisor.

Example 10 : Divide 40.96 by 0.032.

Solution : We multiply both the dividend and the divisor by 1000 (why?) and get dividend = 40.96 × 1000 = 40960

divisor = 0.032 × 1000 = 32

$$\begin{array}{r}
1280\\
32\,\overline{)\,40960}\\
\underline{32}\\
89\\
\underline{64}\\
256\\
\underline{256}\\
\underline{0}
\end{array}$$

Since 40960 ÷ 32 = 1280

Therefore, 40.96 ÷ 0.032 = 1280

5.9 Division of a Decimal by 10, 100, 1000, etc.

Let us carry out some divisions of decimals in which the divisors are 10, 100, 1000, etc.

(i) 12.4 ÷ 10 = 1.24

$$\begin{array}{r}
1.24\\
10\,\overline{)12.40}\\
\underline{10}\\
24\\
\underline{20}\\
40\\
\underline{40}\\
0
\end{array}$$

We note that by moving the decimal point of the dividend one place to the left we get the quotient.

(ii) 320.45 ÷ 100 = 3.2045

$$\begin{array}{r}
3.2045\\
100\,\overline{)320.4500}\\
\underline{300}\\
204\\
\underline{200}\\
450\\
\underline{400}\\
500\\
\underline{500}\\
0
\end{array}$$

We note that by moving the decimal point of the dividend two places to the left we get the quotient.

(iii) 1256.20 ÷ 1000 = 1.2562

$$
\begin{array}{r}
1.2562 \\
1000\overline{)1256.2000} \\
\underline{1000} \\
2562 \\
\underline{2000} \\
5620 \\
\underline{5000} \\
6200 \\
\underline{6000} \\
2000 \\
\underline{2000} \\
\underline{0}
\end{array}
$$

We note that by moving the decimal point of the dividend three places to the left we get the quotient.

In view of the above we conclude:

If we divide a decimal by 10, 100, 1000, etc., we get the required quotient by moving the decimal point of the dividend as many places to the left as there are zeros in the divisor.

Example 11: Divide 1.2 by 100.

Solution: To get the required quotient we have to move the decimal point in 1.2 two places to the left.

We find only one place (that of 1) on the left of decimal point. Since a blank place is considered to be '0', we get the required quotient as

.012

i.e., 1.2 ÷ 100 = 0.012

EXERCISE 5(iv)

1. Divide

(i) 2.6 by 2
(ii) 4.11 by 3
(iii) 25.6 by 16
(iv) 2.55 by 5
(v) 135.75 by 15
(vi) 51.00 by 12
(vii) 3.24 by 12
(viii) 87.99 by 21
(ix) 2523.9 by 47
(x) 94.24 by 19
(xi) 286.02 by 126
(xii) 1704.96 by 333
(xiii) 1375.5 by 105
(xiv) 7.29 by 0.81
(xv) 13.31 by 0.11
(xvi) 525 by 1.05
(xvii) 316.96 by 0.028
(xviii) 267.84 by 0.04
(xix) 65031 by 0.53
(xx) 16.093 by 1.21
(xxi) 65.536 by 25.6
(xxii) 0.027 by 0.03
(xxiii) 0.003 by 0.01
(xxiv) 1 by 2.5

2. Find the quotient orally:

(i) 130.5 ÷ 10
(ii) 25.7 ÷ 10
(iii) 0.6 ÷ 10
(iv) 35.2 ÷ 100
(v) 164.4 ÷ 100
(vi) 20015.1 ÷ 100
(vii) 626.0 ÷ 1000
(viii) 42178.0 ÷ 1000
(ix) .7 ÷ 100
(x) .07 ÷ 10
(xi) 1 ÷ 1000
(xii) 0.90 ÷ 100

3. Divide 137.43 by 9. Write the quotient orally when 137.43 is divided by

(i) 90 (ii) 0.9 (iii) 0.09

4. In each of the following replace □ by the number which makes the statement true:

(i) 13.278 ÷ 2.4 = □ ÷ 24
(ii) 4.234 ÷ 1.25 = □ ÷ 125
(iii) □ ÷ 4 = 7.12 ÷ 40
(iv) 7.29 ÷ □ = 7290 ÷ 81
(v) 3 ÷ 500 = □ ÷ 5
(vi) 0.081 ÷ □ = 81 ÷ 750

5. Find the value of

(i) 0.25 + 0.5 ÷ 0.25
(ii) 0.1 × 0.1 + 1.21 ÷ 1.1
(iii) 51.2 ÷ 1.6 − 16 × 1.5
(iv) 0.75 ÷ (0.25 × 0.3)
(v) 150 ÷ 0.75 − 150 × 0.75
(vi) 14.4 ÷ 1.2 + 14.4 × 1.2

5.10 Everyday Life Problems Involving Decimals

Example 12: Convert

(i) 1750 grams into Kilograms.

(ii) 1203 centimetres into metres.

Solution: (i) We know that

1 kg = 1000 g

Therefore to convert grams into kilograms we divide the given number of grams by 1000.

1750 g = (1750 ÷ 1000) kg

= 1.750 kg

= 1.75 kg

(ii) We know that

1 m = 100 cm

Therefore, 1203 cm = (1203 ÷ 100) m

= 12.03 m

Example 13: The average speed of a train is 60.75 km per hour. How far will the train go in 6 hours?

Solution: Distance covered by the train in 1 hour

= 60.75 km

Distance covered in 6 hours

= (60.75 × 6) km

= 364.50 km

= 364.5 km

Example 14: A bowler took 120 wickets for 4233 runs. Find his average of runs per wicket.

Note: Average of runs per wicket means
'total number of runs given ÷ total number of wickets taken'

Solution: For 120 wickets he gave 4233 runs.
For 1 wicket he gave (4233 ÷ 120) runs
Hence his average of runs per wicket is
4233 ÷ 120, i.e., 35.25

EXERCISE 5(v)

1. Convert
   (i) 2.3 kilograms into grams.
   (ii) 4.55 litres into millilitres.
   (iii) 1.35 metres into centimetres.
   (iv) 2518 centimetres into metres.
   (v) 2350 grams into kilograms.
   (vi) 67290 millilitres into litres.
   (vii) 1150 kilograms into quintals.
   (viii) 7.5 quintals into tons.
2. Find the perimeter of a rectangle whose length and breadth are 4.3 cm and 2.5 cm respectively.
3. A batsman scored 482 runs in 8 innings. Find his average score per inning.
4. A bowler took 25 wickets for 495 runs. Find his average of runs per wicket.
5. Find the area of a rectangle whose length and breadth are 6.2 cm and 2.5 cm respectively.
6. 1.65 m of cloth is used for one shirt. How much cloth (in metres) will be required for 24 such shirts?
7. A train travels 447.48 km in 6 hours. How many kilometres does it travel in
   (i) 1 hour?
   (ii) 4 hours?
8. The cost of 30.275 kg of potatoes is Rs 35. How much potatoes can we buy for
   (i) 1 rupee?
   (ii) 25 rupees?

9. 8.75 litres of milk is distributed equally among 35 students. How much milk will each student get?

10. A car travels at an average speed of 40.5 km per hour. How much distance will it cover in
    - (i) 6 hours?
    - (ii) 8 hours?

11. Ten bags of rice of equal weight together weigh 350.50 kg. Find the weight of
    - (i) 1 bag.
    - (ii) 8 bags.

12. A bottle contains 57 ml of ink. How many litres of ink are there in
    - (i) 5 such bottles?
    - (ii) 8 such bottles?

13. A furnance burns 452 g of coal every minute. Find in kilograms, the coal burnt in
    - (i) 8 hours.
    - (ii) 10 hours.

14. A tap, when open, allows 15 ml of water to flow out in one second. How much water, in litres, will flow out if the tap is opened for half an hour?

15. The water in a bottle, half full, weighs 225.5 g. Find the weight of water when the bottle is $\frac{3}{4}$ full.

16. Girish buys 5 inland-letters (each costing 35 p) 4 postal envelops (each costing 50 p) and 7 postcards (each costing 15 p). Find the total amount in ruppees and paise paid by him.

17. Gopal had Rs 30 with him. He bought 13 stamps of 25 paise each, 17 stamps of 50 paise each and three dozen revenue stamps each costing 20 paise. Find the total money spent by Gopal and the balance left with him.

UNIT VI

ORDER OF OPERATIONS AND GROUPING SYMBOLS

6.1 Order of Operations

We are already familiar with four fundamental operations—addition (+), subtraction (−), multiplication (×) and division (÷) on whole numbers and fractions. Many times in a numerical expression we find two or more of these operations occurring together. To simplify such an expression we follow certain conventions. Let us study the following examples:

Example 1: Solve $5 + 3 \times 4$

Solution:
$$\begin{aligned}5 + 3 \times 4 &= 5 + 12\\ &= 17\end{aligned}$$

Note: We first multiply 3 and 4 and then add 5 to the product.

Example 2: Solve $12 \div 4 + 2$

Solution:
$$\begin{aligned}12 \div 4 + 2 &= 3 + 2\\ &= 5\end{aligned}$$

Note: We first divide 12 by 4 and then add 2 to the quotient.

Rule: We perform operations sequentially from left to right in the order— division, multiplication, addition, subtraction.

Examples:

$2 - 6 \div 3 = 2 - 2 = 0$

$15 - 2 \times 4 = 15 - 8 = 7$

$20 + 7 + 5 = 27 + 5 = 32$

$4 - 7 + 8 = 4 + 8 - 7 = 12 - 7 = 5$

A note to the teacher: when the operations of division and multiplication occur simultaneously (as in $36 \div 6 \times 3$) without an operation of addition or subtraction between them, some mathematicians are of the opinion that first performing the operation of division is not sound and appropriate as the two operations are interchangeable by means of a reciprocal. To avoid confusion, in such situations which of the two operations—multiplication or division, is to be first performed, must be indicated by ( ). The use of expression such as '$36 \div 6 \times 3$' must be avoided. If the operation of division is to be first performed, it must be expressed as '$(36 \div 6) \times 3$', if that of multiplication is to be first performed, it must be expressed as '$36 \div (6 \times 3)$'. On the same grounds, the use of expressions such as '$36 \div 6 \div 3$' must be avoided.

Example 3. Find the value of

(i) $18 - 4 \times 3 - 2$

(ii) $30 + 6 \div 3 - 2 \times 5$

Solution:

(i) $$\begin{aligned} 18 - 4 \times 3 - 2 &= 18 - 12 - 2 \\ &= 6 - 2 \\ &= 4 \end{aligned}$$

(ii) $$\begin{aligned} 30 + 6 \div 3 - 2 \times 5 &= 30 + 2 - 10 \\ &= 32 - 10 \\ &= 22 \end{aligned}$$

Example 4: Simplify:

(i) $1 - \frac{2}{3} \times 1\frac{1}{2}$

(ii) $5\frac{1}{4} + 3\frac{1}{8} \div 1\frac{1}{4} - 1\frac{1}{4}$

Solution:

(i) $$\begin{aligned} 1 - \frac{2}{3} \times 1\frac{1}{2} &= 1 - \frac{2}{3} \times \frac{3}{2} \\ &= 1 - 1 \\ &= 0 \end{aligned}$$

(ii) $$\begin{aligned} & 5\frac{1}{4} + 3\frac{1}{8} \div 1\frac{1}{4} - 1\frac{1}{4} \\ &= \frac{21}{4} + \frac{25}{8} \div \frac{5}{4} - \frac{5}{4} \\ &= \frac{21}{4} + \frac{25}{8} \times \frac{4}{5} - \frac{5}{4} \text{ (Why?)} \\ &= \frac{21}{4} + \frac{5}{2} - \frac{5}{4} \\ &= \frac{21 + 10 - 5}{4} \\ &= \frac{26}{4} \\ &= \frac{13}{2} \\ &= 6\frac{1}{2} \end{aligned}$$

6.2 Use of Grouping Symbols

Many times we come across situations wherein we have to treat two or more terms of an expression as a single group. For example, if we want to divide 21 by the sum of 3 and 4, we treat the sum of 3 and 4, i.e. '3 + 4' as a single group. We first add 3 and 4 and then divide 21 by their sum, i.e., 7. In such a case, we use a grouping symbol, say ( ), and write it as

$$21 \div (3 + 4)$$

We note that if we do not use the grouping symbol, the expression becomes $21 \div 3 + 4$ which means something else. Therefore, the use of a grouping symbol becomes essential.

In many situations grouping of terms within a second group has to be indicated. In such cases we use different grouping symbols so that we can easily know which terms are combined together. For example, when we say '120 divided by the number one less than the sum of 5 and 8', we treat '5 + 8' as one group and write $(5 + 8)$ for this group, and treat $(5 + 8) - 1$ as the second group and write $\{(5 + 8) - 1\}$ for this group. Thus, the expression becomes

$$120 \div \{(5 + 8) - 1\}$$

Most commonly used grouping symbols are as follows.

Grouping symbol	Name
( )	Parentheses or common brackets
{ }	Braces or curly brackets
[ ]	Brackets or square brackets

The left part of each symbol indicates its start and the right part indicates its end. Conventionally we use grouping symbols in the following order from innermost to outermost:

( )   { }   [ ]

If, in an expression, more than one grouping symbols are used, we first remove the innermost grouping symbol, next the innermost symbol of all that remain, and so on.

A note to the teacher: Sometimes groupings within groups are to the extent that the three symbols mentioned above are not sufficient if all used once. In such cases we may use another grouping symbol '—' called **'bar'** which in order comes first, i.e., it occurs innermost and is placed over the terms like '$54 \div \overline{2 + 4}$'. If still there is a need of another grouping symbol, we may repeat one or more of the above mentioned grouping symbols by making it slightly bigger in size.

While removing grouping symbols we keep in mind that **we mean 'multiplication' when there is no sign of operation between a number and grouping symbol.** Thus,

$$8\,(5-3) = 8 \times (5-3)$$

Let us now consider some examples that will make the process of removing grouping symbols more clear.

Example 5: Find the value of

$28 - \{15 - (7 - 5)\}$

Solution: $28 - \{15 - (7 - 5)\}$

$= 28 - \{15 - 2\}$

$= 28 - 13$

$= 15$

Example 6: Find the value of

$17 - [3 + \{18 - (19 - 2)\}]$

Solution: $17 - [3 + \{18 - (19 - 2)\}]$

$= 17 - [3 + \{18 - 17\}]$

$= 17 - [3 + 1]$

$= 17 - 4$

$= 13$

Example 7: Simplify;

$6 + 2[3 + 5\{28 - 12(12 - 10)\}]$

Solution: $6 + 2[3 + 5\{28 - 12(12 - 10)\}]$

$= 6 + 2[3 + 5\{28 - 12 \times 2\}]$

$= 6 + 2[3 + 5\{28 - 24\}]$

$= 6 + 2[3 + 5 \times 4]$

$= 6 + 2[3 + 20]$

$= 6 + 2 \times 23$

$= 6 + 46$

$= 52$

Example 8: Simplify:

$2.5 - [13.9 - \{21.2 - 2.3 - (6.8 - 1.8)\}]$

Solution: $2.5 - [13.9 - \{21.2 - 2.3 - (6.8 - 1.8)\}]$

$= 2.5 - [13.9 - \{21.2 - 2.3 - 5\}]$

$= 2.5 - [13.9 - \{18.9 - 5\}]$

$= 2.5 - [13.9 - 13.9]$

$= 2.5 - 0$

$= 2.5$

EXERCISE 6

1. Find the value of

(i) $24 + 15 \div 3$ (ii) $120 - \frac{1}{2} \times 20$

(iii) $5.8 \times 3.2 - 5.8 \times 1.2$

(iv) $3\frac{1}{3} + 1.5 \div 7.5$

(v) $2\frac{1}{4} - 2 \times \frac{1}{4}$

(vi) $14\frac{5}{8} \times \frac{5}{9} - 2\frac{1}{5} \div 7\frac{1}{3}$

(vii) $12 - (3 \times 5) + 3$

(viii) $2.5 + (1.7 - 0.5) - 0.3$

(ix) $2\frac{3}{8} + (5\frac{3}{4} - 3\frac{1}{2}) - \frac{2}{5}$

(x) $2\,(4.5 - 0.2 \times 20) + 3.8$

(xi) $7\frac{1}{2} \times 5\frac{1}{2} - 7\frac{1}{2} \times 4\frac{1}{2}$

(xii) $13.65 - 1.35 \div \frac{3}{20} \times 0.75$

2. Using grouping symbols, write a mathematical expression for each of the following:
   - (i) Five multiplied by the sum of two and three
   - (ii) Twelve divided by the difference of seven and four
   - (iii) Eight subtracted from the product of two and the sum of five and nine
   - (iv) Forty divided by one more than the sum of nine and six
   - (v) Two multiplied by one less than the difference of nineteen and six
   - *(vi) One less than the product of four and five subtracted from two more than the difference of fifty and five

3. Simplify:

(i) $5\,\{12 - (1 + 3)\}$ (ii) $20 + \{10 - 5 + (7 - 3)\}$

(iii) $81\,[59 - \{7 \times 8 + (13 - 2 \times 5)\}]$

(iv) $[(10.6 \div 0.03) - 20] \times \{(17 \times 5) - 5\}$

(v) $121 \div [17 - \{15 - 3\,(7 - 4)\}]$

(vi) $1.4\,\{3.2 - 2\,(2.1 - 0.8)\}$

(vii) $3(5.3 - 2.1) - 1.2\,(1.8 - 0.8)$

(viii) $3[18 + \{3 + 4\,(4 - 2)\}]$

(ix) $(14 - 7) \times [8 + \{3 + (7 - 1)\}]$

(x) $18 + [1 + (15 - 2) \times 4]$

(xi) $2\,\{(18 - 3) + 5\,(12 - 7)\}$

(xii) $[20 + \{15 - (10 - 3)\}] - 2.5$

(xiii) $3\,[(5 - 3) + 2\,(7 - 4)]$

(xiv) $\{(5 + 25) \times 3 - (10 - 8)\} - (8 + 12)$

(xv) $15 - 3\,\{4 - (7 - 3)\} + 3\,(5 + 2 - 1)$

(xvi) $2.8\,\{4.3 + 6(5.3 + 2.7) - 8.1\}$

(xvii) $2 + 7.9\,\{2.8 + 0.3\,(2.1 - 0.5) + 15.6\}$

(xviii) $\frac{1}{2} + 2\left[3\frac{1}{2} - \{\frac{17}{2} - 3\,(\frac{1}{6} + \frac{5}{3})\}\right]$

(xix) $22\frac{1}{4} - 5\,[2 + 6\,(\frac{1}{3} - \frac{1}{4}) - \frac{1}{5}\,(5 - 3\frac{1}{3})]$

(xx) $14\frac{2}{5} + \frac{1}{2}\left[4\frac{1}{2} - \{3.2 + 2(1 - \frac{7}{20})\}\right]$

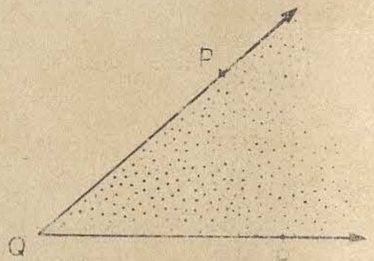
UNIT VII

LINES AND ANGLES

7.1 Review

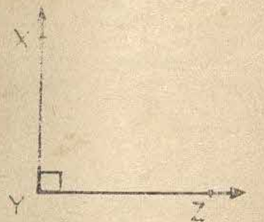
In Class IV we learnt that two rays with a common endpoint form an angle. The amount of rotation indicated by one ray with respect to the other is the angle described.

In the figure on the right the rays QP and QR have the same endpoint namely, Q. The angle formed is PQR or RQP. QP and QR are its **sides** or **arms** and Q its **vertex.** The **interior** of $\angle PQR$ has been shaded.

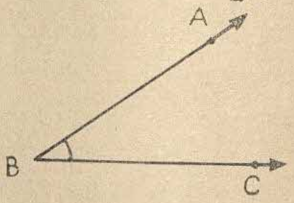


We measure angles in degrees with the help of a protractor. According to their measures we have names for various kinds of angles:

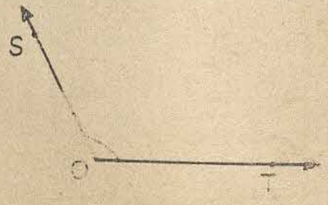
(i) An angle, whose measure is 90°, is called a **right** angle.



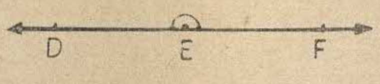
(ii) An angle whose measure lies between o° and 90° is called an **acute** angle.



(iii) An angle whose measure lies between 90° abd 180° is called an **obtuse** angle.



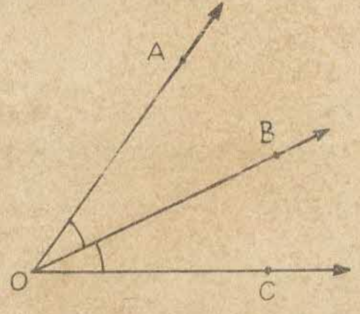
(iv) An angle, whose measure is 180°, is called a **straight** angle.



In the same class we also studied how to measure a given angle with the help of a protractor and how to draw an angle of a given measure. Let us now learn more about angles.

7.2 Pairs of Angles

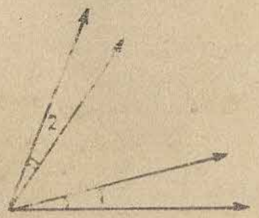
I. *Adjacent Angles:* **Two angles are called adjacent angles if they**

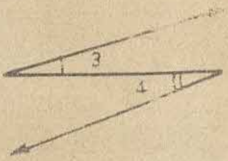


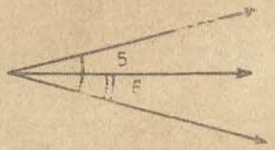
(i) are non-overlapping,
(ii) have the same vertex and
(iii) have one common arm.

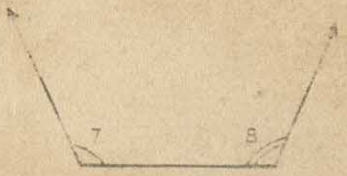
In the figure on the right, the angles AOB and BOC are adjacent angles. O is their common vertex and OB their common arm.

None of the following pairs of angles is a pair of adjacent angles. (Why?)



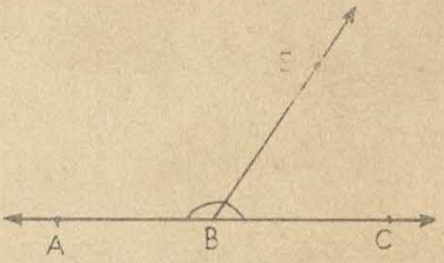






II. *Supplementary Angles:* Two angles, whose sum is 180°, are called supplementary angles and either is called the supplement of the other.

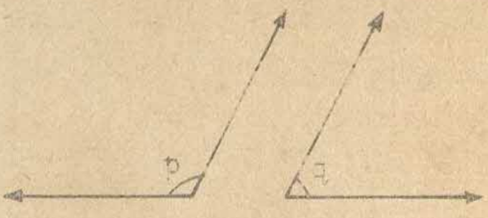
Let us draw a straight angle, say ∠ABC in our exercise book as drawn here. Next we draw a ray BE



$\angle ABE + \angle CBE = 180°$ (Why?)

∠ABE and ∠CBE are supplementary angles. ∠ABE is the supplement of ∠CBE and ∠CBE is the supplement of ∠ABE. We note that angles ABE and CBE are adjacent angles.

Let us now measure the angles p and q drawn here and find their sum. We find



$\angle p + \angle q = 180°$

Therefore, $\angle p$ and $\angle q$ are supplementary angles. $\angle p$ is the supplement of $\angle q$ and $\angle q$ that of $\angle p$. Obviously $\angle p$ and $\angle q$ are not adjacent angles. We see that for two angles to be supplementary, it is not necessary that they are adjacent.

To find the supplement of a given angle, we subtract its measure from 180°

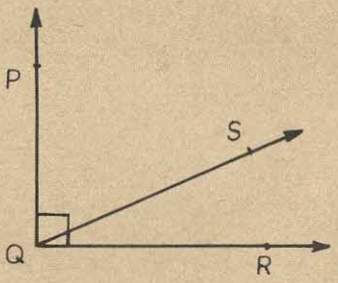
Example 1: Find the supplement of 45° angle.

Solution: Since $180° - 45° = 135°$, we find that the supplement of 45° angle is 135° angle.

III. *Complementary Angles:* **Two angles, whose sum is 90°, are called complementary angles and either is called the complement of the other.**

Let us draw a right angle, say $\angle PQR$, in our exercise book as drawn here.

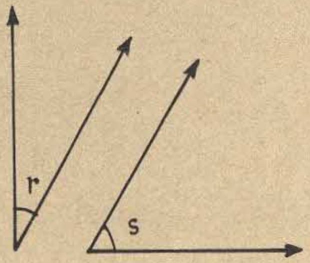
Next we draw a ray QS in its interior.



$$\angle PQS + \angle RQS = 90°$$

$\angle PQS$ and $\angle RQS$ are complementary angles. $\angle PQS$ is the complement of $\angle RQS$ and $\angle RQS$ that of $\angle PQS$. We note that $\angle PQS$ and $\angle RQS$ are adjacent angles.

Let us now measure the angles r and s drawn here and find their sum. We find



$$\angle r + \angle s = 90°$$

Therefore, $\angle r$ and $\angle s$ are complementary angles. $\angle r$ is the complement of $\angle s$ and $\angle s$ that of $\angle r$. Obviously $\angle r$ and $\angle s$ are not adjacent. We see that for two angles to be complementary, it is not necessary that they are adjacent.

To find the complement of a given angle, we subtract its measure from 90°.

Example 2: Find the complement of 75° angle.

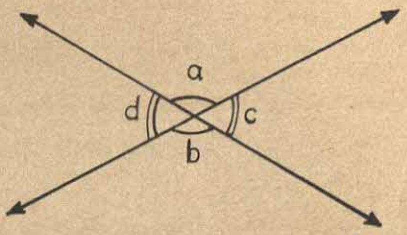
Solution: Since $90° - 75° = 15°$, we find that the complement of 75° angle is 15° angle.

IV. *Vertically Opposite Angles:* **Any two angles, that are formed by two intersecting lines and which are not adjacent, are called vertically opposite angles.**

Two lines that intersect in a point always form two pairs of vertically opposite angles. In the figure drawn here ∠a and ∠b form one pair of vertically opposite angles and ∠c and ∠d form the other pair.

Let us measure ∠a, ∠b, ∠c and ∠d. We find ∠a = ∠b and ∠c = ∠d.

We conclude:

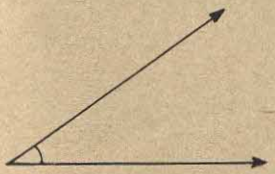


Vertically opposite angles are equal.

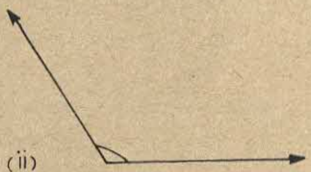
EXERCISE 7(i)

1. Classify the following angles as acute, right, obtuse or straight:
   (i) 65° (ii) 140° (iii) 100°
   (iv) 90° (v) 180° (vi) 1°
2. Measure the following angles and in each case write the kind of the angle:

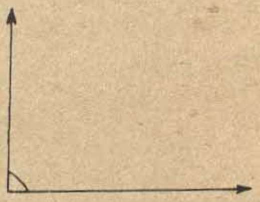
(i)



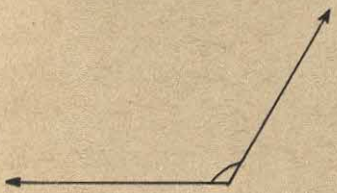
(ii)



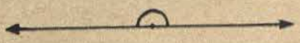
(iii)



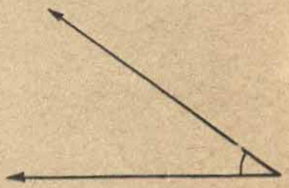
(iv)



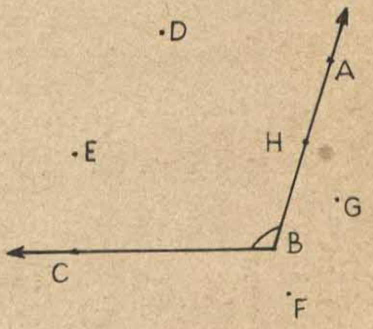
(v)



(vi)



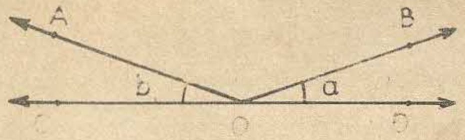
3. Draw angles having the following measures:
   (i) 60° (ii) 30° (iii) 105°
   (iv) 150° (v) 12° (vi) 4°
4. In the figure given on the right, name the points that are:
   (i) in the interior of ∠ABC.
   (ii) in the exterior of ∠ABC.
   (iii) on ∠ABC.

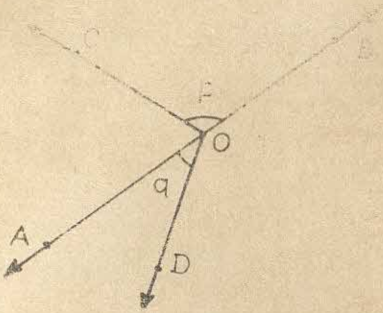


5. Draw a pair of
   (i) adjacent angles.
   (ii) complementary angles.
   (iii) supplementary angles.

6. Draw two lines AB and CD intersecting in a point O. Name
   (i) the two pairs of vertically opposite angles
   (ii) four pairs of adjacent angles each containing an acute and an obtuse angle.
   (iii) four pairs of supplementary angles
7. Draw a pair of complementary angles such that one of them measures
   (i) 25° (ii) 45° (iii) 60°
8. Draw a pair of supplementary angles such that one of them measures
   (i) 75° (ii) 135° (iii) 110°
9. Give the complement of
   (i) 40° (ii) 55° (iii) 62°
10. Give the supplement of
   (i) 160° (ii) 30° (iii) 136°

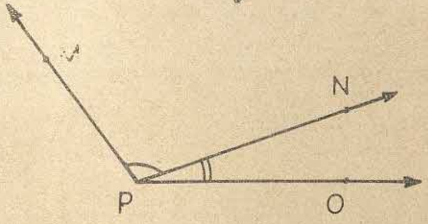
11. In the figure given on the right, measure ∠a and ∠b. Are they vertically opposite angles? Give reasons in support of your answer.



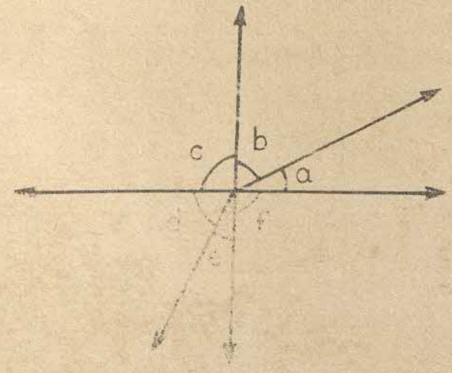


12. Are angles p and q, in the figure given here, vertically opposite angles? Give reasons in support of your answer.

13. In the figure given on the right, are ∠MPN and ∠NPO
   (i) complementary?
   (ii) supplementary?
   (iii) adjacent?



14. With reference to the figure on the right, give as many pairs as you can of
   (i) supplementary angles
   (ii) complementary angles
   (iii) vertically opposite angles.



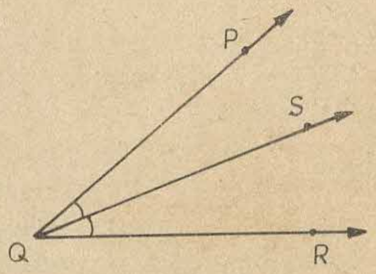
*15. Which angle is equal to its complement?

*16. Which angle is equal to its supplement?

17. Which of the following statements are true?
    - (i) The sum of two adjacent angles equals 180°
    - (ii) Adjacent angles can be complementary.
    - (iii) Supplement of a given angle is always obtuse.
    - (iv) If two lines intersect in a point, one pair of vertically opposite angles is always made up of acute angles and the other of obtuse angles.

7.3 Bisector of an Angle

Let us draw an angle, say ∠PQR, on a piece of paper. We cut the paper along the arms QR and QP of the angle. Next, we fold the cutting into a half so that the arms QR and QP coincide. Finally we press the paper and unfold into its original position. We find a crease made in the interior of ∠PQR. We have named the crease as QS here.



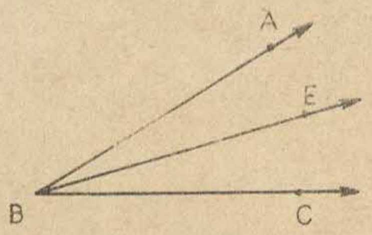
Let us measure ∠SQR and ∠PQS. We find ∠PQS = ∠SQR. Each of ∠PQS and ∠SQR is half of ∠PQR. (Why?) QS is called the **bisector** of ∠PQR.

A ray, whose endpoint is the vertex of an angle and which divides the angle into two equal parts, is called the bisector of the angle.

We can find the bisector of a given angle with the help of our protractor. The phrase 'to bisect an angle' means 'to find the bisector of an angle'.

To bisect a given angle with the help of a protractor, we take the following steps:

Step 1: We draw the angle, say ∠ABC of given measure say 30°.



Step 2: We find half the measure of ∠ABC (here 15°).

Step 3: We place the centre of our protractor on B and adjust the protractor such that the base line is along BC.

Step 4: We choose the scale, inner or outer, whose 0° is on BC.

Step 5: We mark a point, say E, on the paper against the number (obtained in Step 2) of the scale chosen in Step 4.

Step 6: We remove the protractor.

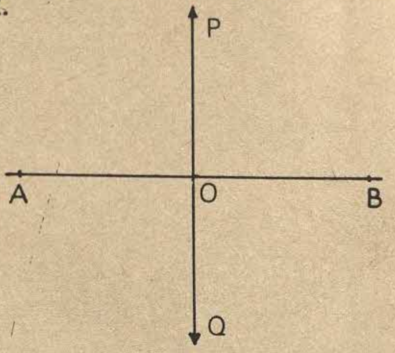
Step 7: We draw the ray BE.
BE is the required bisector of ∠ABC.

7.4 Perpendicular Bisector of a Line-segment

We know that if two lines are at right angles to each other, they are called perpendicular lines.

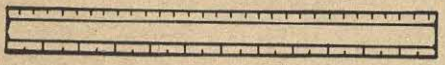
A line or a ray is called the perpendicular or right bisector of a given line-segment if it is perpendicular to the line-segment at its midpoint.

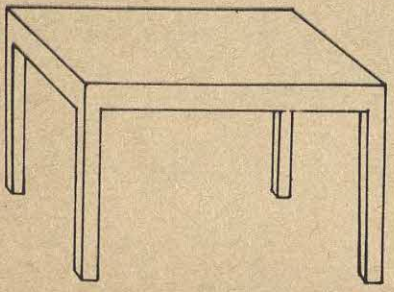
Obviously to draw the perpendicular bisector of a line-segment, say AB, we first mark the mid-point O of AB and then draw PQ perpendicular to AB through O with the help of protractor or set-square.

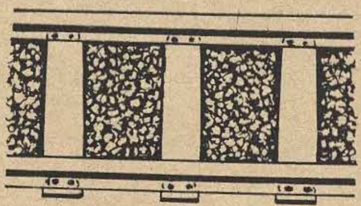


7.5 Parallel Lines

The opposite edges of a ruler, a rectangular table or a book and the rails of a railway-track are some examples of parallel lines.

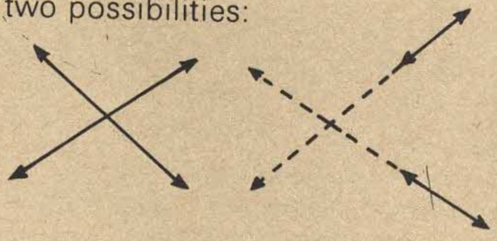




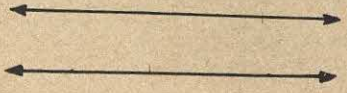


Given two lines in a plane, there are only two possibilities:

(i) They intersect:



(ii) They do not intersect:



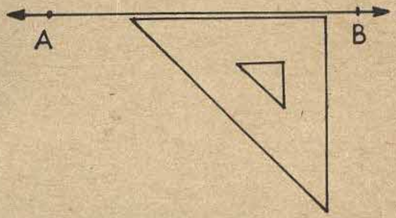
When two lines lie in a plane and do not intersect, they are called parallel lines and either is said to be parallel to the other.

The easiest way to draw two parallel lines is to draw lines along the opposite edges of a ruler.

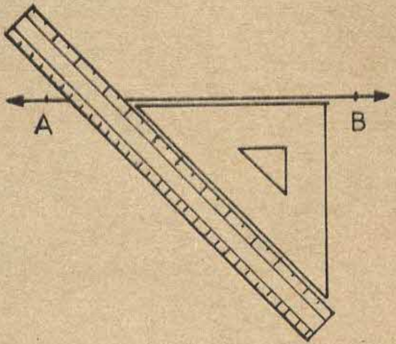
We can also draw a line parallel to a given line by using a ruler and a set-square. To do so we proceed as follows:

Let AB be the given line.

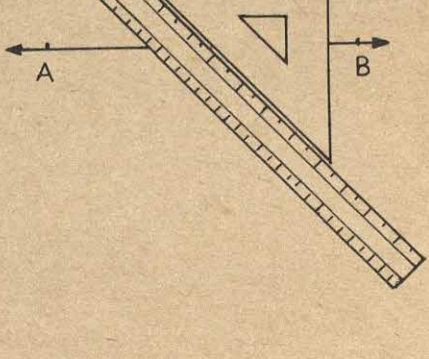
Step 1: We place one of the perpendicular edges of a set-square along the line AB.



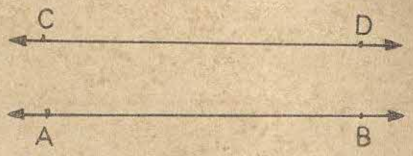
Setp 2: We place the ruler along one of the other edges of the set-square. (See the figure on the right)



Step 3: We hold the ruler fixed and slide the set-square along the edge of the ruler through some distance upwards or downwards.

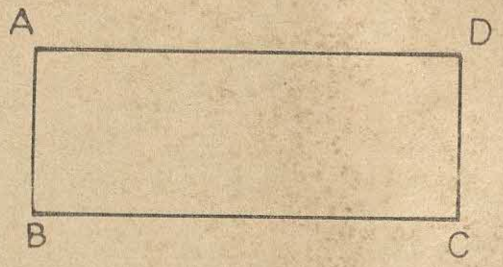


Step 4: We draw a line, say CD, along that edge of the set-square which was along AB in Step 1.
CD is a line parallel to AB.

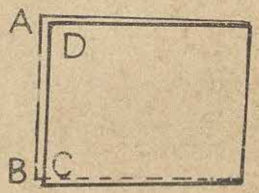


We write CD||AB. The symbol '||' stands for 'is parallel to'.

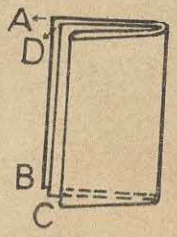
Activity: We take a rectangular piece of paper, say ABCD.



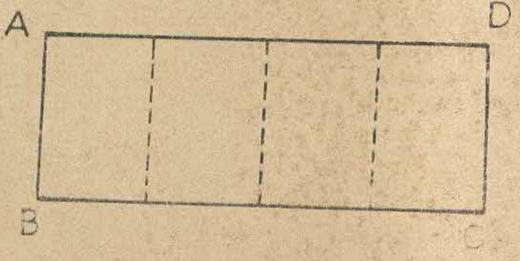
We fold the paper into a half so that its opposite edges, say AB and CD coincide.



Next we fold the folded paper into another half so that the fold is not folded.



By pressing the folds gently we unfold the paper into its original position. We get three creases made on the paper. If we draw lines along the creases, we get three lines parallel to each other.

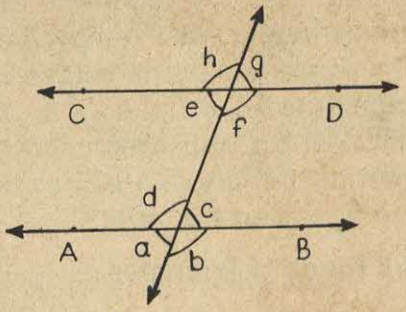


A note to the teacher: The teacher should help children in performing the same activity by coinciding the other pair of opposite edges.

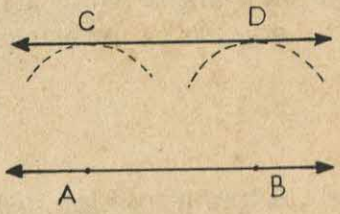
EXERCISE 7(ii)

1. Draw angles having the following measures then use the protractor to bisect each of them.
(i) 50°
(ii) 80°
(iii) 110°
(iv) 160°
(v) 90°
(vi) 30°

2. Draw an acute angle on a paper. Cut the paper along its arms. Fold the cutting into a half and then into another half so that the creases divide the angle into four equal parts.
3. Draw angles having the following measure; then use your protractor to divide each of them into four equal parts:
   (i) 120° (ii) 160° (iii) 90°
4. Draw a triangle and draw the bisectors of the three angles of the triangle. Do the three bisectors meet in a point?
5. Draw a line-segment of length 5 cm. Draw the right bisector of the line-segment. Take any point on the right bisector and measure its distance from the endpoints of the line-segment. Are the two measures equal?
6. Draw a triangle and draw the perpendicular bisector of each of its sides. Do the three perpendicular bisectors meet in a point?
7. How many bisectors of a line-segment can you draw? How many perpendicular bisectors?
8. Draw a circle of radius 3.5cm. Draw any chord of this circle and the perpendicular bisector of this chord. Does the perpendicular bisector pass through the centre of the circle?
9. Construct any triangle. Through each vertex draw the line parallel to opposite side of the triangle. Measure the lengths of the sides of the triangle thus formed.
10. Draw any two parallel lines, say AB and CD. Draw a third line intersecting both AB and CD. (See the figure on the right.) Measure angles, a, b, c, d, e, f, g and h.



11. Draw a line AB. With centre A and any radius draw an arc. With centre B and the same radius, draw another arc on the same side of the line AB. Draw a line through the upper most points say C and D, of the two arcs. Is the line CD parallel to AB? Verify with the help of set-square and ruler.

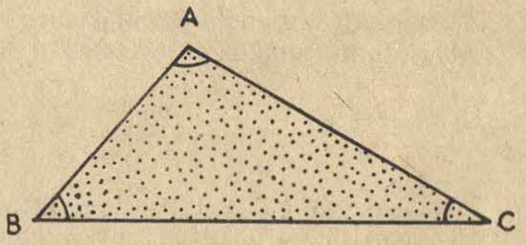


UNIT VIII

TRIANGLES QUADRILATERALS AND CIRCLES

8.1 Triangles

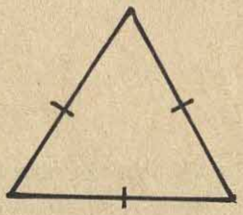
We have learnt about triangles in earlier classes. Let A, B, C, be three non-collinear points. The line-segments AB, BC and CA form **triangle ABC**, denoted as **△ABC**. A, B and C are called its **vertices** and the line-segments AB, BC and CA as its **sides.** ∠ABC, ∠BCA and ∠CAB are called its **angles.** The **interior** of triangle ABC has been shaded in the figure on the right.



8.2 Kinds of Triangles

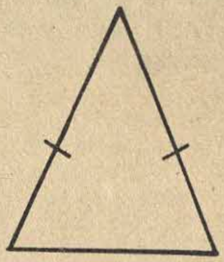
I. Triangles classified by their sides

(i) A triangle which has all of its sides equal is called an **equilateral** triangle.

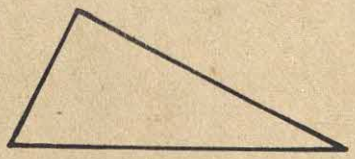


(ii) A triangle which has two sides equal is called an **isosceles** triangle.

Note: Every equilateral triangle is also isosceles.

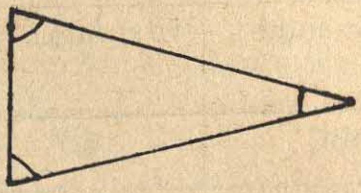


(iii) A triangle which has no pair of equal sides is called a **scalene triangle.**

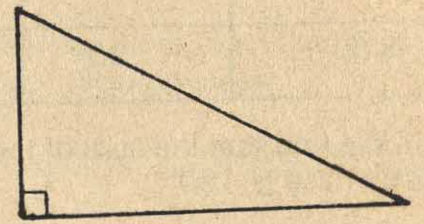


II. Triangles classifield by their angles

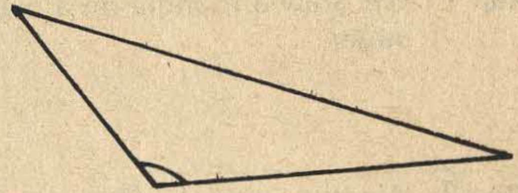
(i) A triangle which has all of its angles acute is called an **acute triangle** or **acute-angled triangle.**



(ii) A triangle which has one right angle is called a **right triangle** or **right-angled triangle.**



(iii) A triangle which has one obtuse angle is called an **obtuse triangle** or **obtuse-angled triangle.**



8.3 Properties of Triangles

(i) Every equilateral triangle has all of its angles equal and vice-versa.

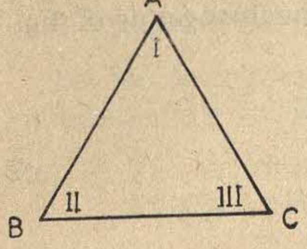
(ii) An acute triangle may be scalene, isosceles or equilateral.

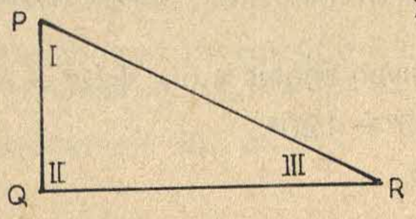
(iii) An obtuse triangle may be either scalene or isosceles.

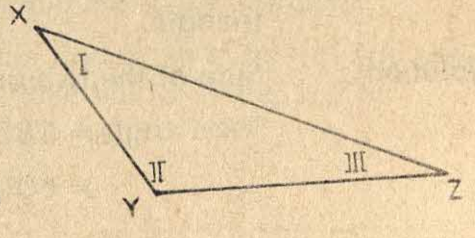
(iv) A right triangle may be either scalene or isosceles.

8.4 Sum of the Angles of a Triangle

Let us measure the angles of the triangles ABC, PQR and XYZ drawn below and fill in the cells of the following table:





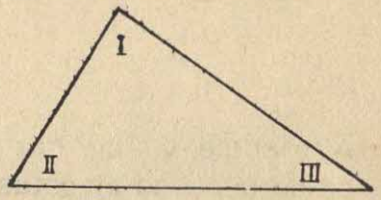


Triangle	First Angle	Second Angle	Third Angle	Sum of the three Angles
ABC	60°	60°	60°	180°
PQR	60°	90°	30°	180°
XYZ	30°	130°	20°	180°

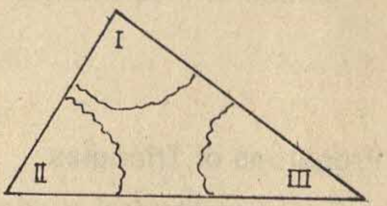
We find that the sum of the measures of the three angles of the triangle in each case is 180°.

Let us now perform the following experiment:

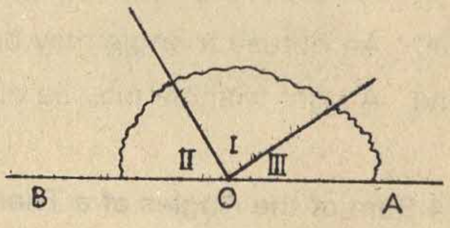
Step 1: We draw a triangle on a piece of paper.



Step 2: We cut apart the three angles of the triangle by cutting along the sides.



Step 3: We put the three cut-out angles close to each other so that I is adjacent to both II and III. (See the figure on the right.)



We find that the outer sides of the angles II and III are in one line. This shows that $\angle AOB = 180°$ (Why?). i.e., $\angle I + \angle II + \angle III = 180°$
Hence, we conclude:

The sum of the three angles of a triangle is 180°.

Example 1: The two angles of a triangle are 50° and 70°. Find the third angle of the triangle.

Solution: Sum of the two given angles $= 50° + 70° = 120°$

Third angle $= 180° - 120°$

$= 60°$

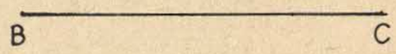
Note: Since all of the angles of an equilateral triangle are equal, the measure of each angle of an equilateral triangle is 180° ÷ 3, i.e., 60°.

8.5 Construction of Triangles

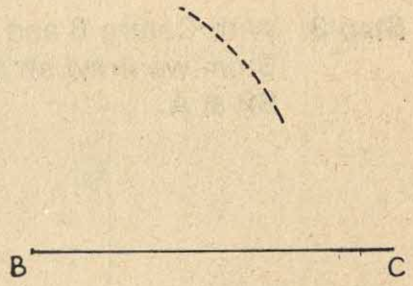
I. *To construct a triangle whose sides are given*

Let the lengths of the three sides of the triangle be 6 cm, 5 cm and 4 cm respectively. To construct the triangle we take the following steps:

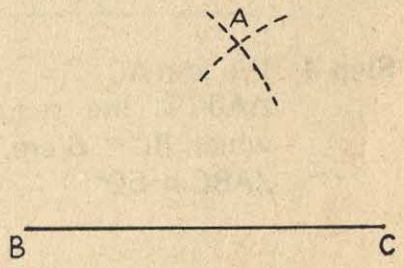
Step 1: We draw a line segment BC of length 6 cm.



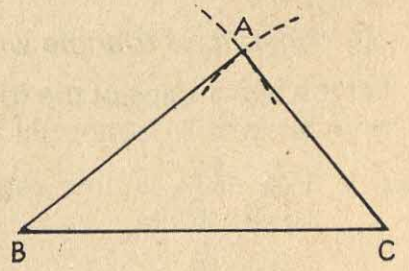
Step 2: With centre B and radius equal to 5 cm we draw an arc (part of a circle).



Step 3: With centre C and radius equal to 4 cm, we draw another arc intersecting the previous one at point A.



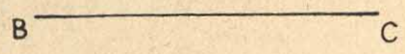
Step 4: We join AB and AC.
△ ABC is the required triangle in which BC = 6 cm, AB = 5 cm and AC = 4 cm



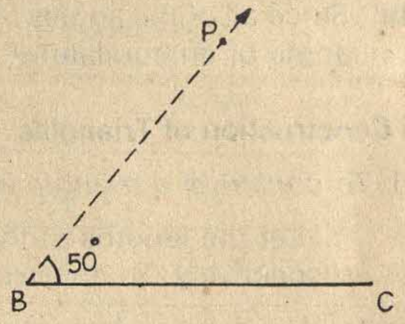
II. *To construct a triangle whose two sides and the included angle are given*

Let the two sides of the triangle be equal to 6 cm and 5 cm in length and the included angle be 50°. To construct the triangle we take the following steps:

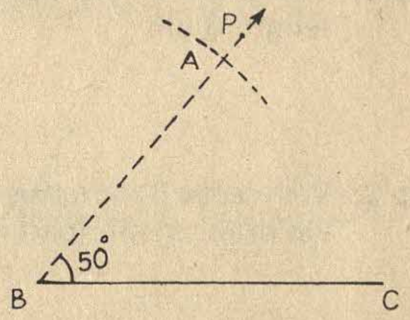
Step 1: We draw a line-segment BC of length 6 cm.



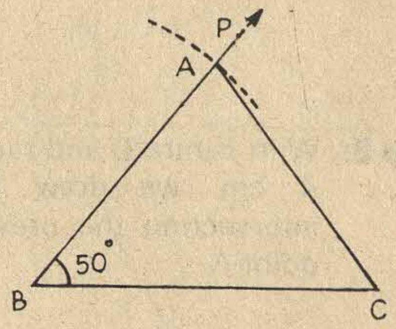
Step 2: With the help of the protractor we draw a ray BP making an angle of 50° with BC, i.e., ∠PBC = 50°



Step 3: With Centre B and radius equal to 5 cm we draw an arc intersecting BP at A.



Step 4: We join AC.
△ABC is the required triangle in which BC = 6 cm, AB = 5 cm and ∠ABC = 50°.

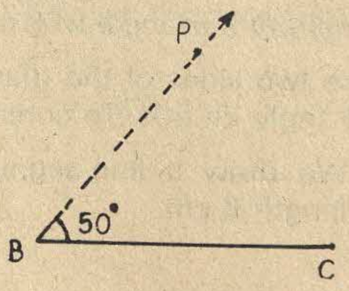


III. *To construct a triangle whose two angles and the included side are given*

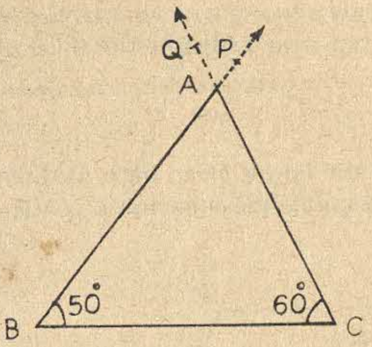
Let the two angles of the triangle be equal to 50° and 60° and the included side be 5 cm in length. To construct the triangle, we take the following steps:

Step 1: We draw a line-segment BC of length 5 cm.

Step 2: At B, we draw ∠PBC equal to 50° as in Step 2 of II above.



Step 3: At C, we draw ∠QCB equal to 60° intersecting PB at A.

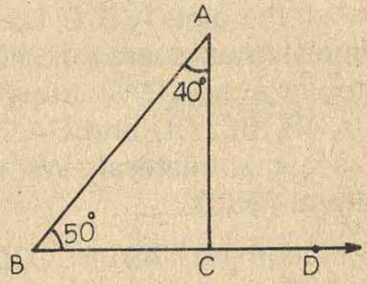


△ ABC is the required triangle, in which ∠ABC = 50°, ∠ACB = 60° and BC = 5 cm.

EXERCISE 8(i)

1. If the sum of two angles of a triangle is 110°, what is the measure of its third angle?

2. In the figure given here,
   (i) what is the measure of ∠ACB?
   (ii) what type of triangle is △ ABC?
   (iii) what is the measure of ∠ACD?

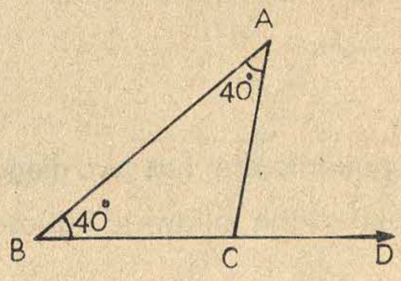


3. Is it possible to have a triangle with two right angles?

4. Is it possible to have a triangle with two obtuse angles?

5. Can we have a triangle whose three angles are
   (i) 60°, 80°, 40°?
   (ii) 80°, 80°, 80°?
   (iii) 60°, 60°, 60°?
   (iv) 50°, 50°, 50°?
   (v) all greater than 60°?
   (vi) all less than 60°?

6. In the figure given on the right, △ ABC is an isosceles triangle, in which angles A and B both equal to 40°. Find the measures of ∠ACB and ∠ACD.

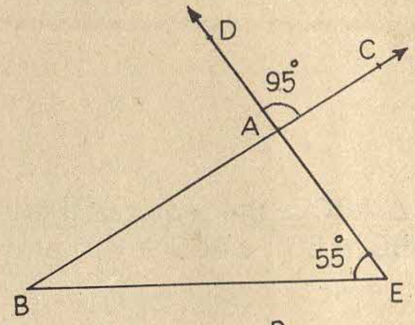


7. Draw a triangle the lengths of whose sides are 6 cm, 8 cm and 10 cm. Measure its angles. Is it a right triangle?

8. Draw a triangle whose two sides are 4.5 cm and 6.5 cm long and the angle included by these sides is 40°. Measure its third side and the remaining two angles.

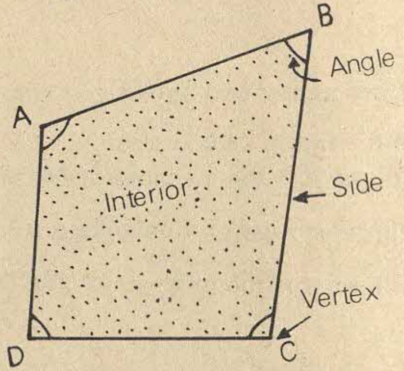
9. Draw a triangle which has two angles equal to 40° and 50° and the side included by them as 6 cm long. Measure the third angle of this triangle and the remaining two sides.

10. In the figure given here, DAE and BAC are lines. Calculate the measure of ∠ABE.



8.6 Quadrilaterals

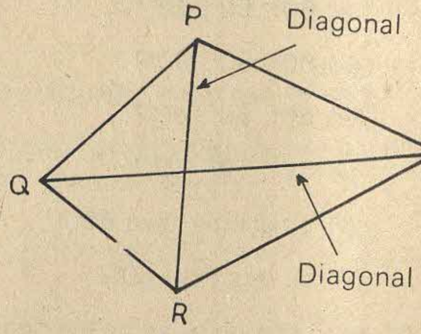
We mark four points A, B, C, D, in order, on our exercise book such that no three of them are in a line. We draw the line-segments AB, BC, CD and DA. The figure formed is a **quadrilateral**. We read it as **'quadrilateral ABCD'**.



The line-segments AB, BC, CD, DA, are called the **sides** of the quadrilateral ABCD. The points A, B, C, D where two sides meet, are called its **vertices.** ∠ABC, ∠BCD, ∠CDA and ∠DAB are its **angles.** The **interior** of the quadrilateral ABCD has been shaded.

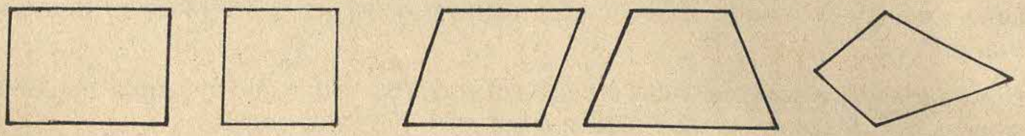
A quadrilateral has four sides, four vertices and four angles.

Here is a quadrilateral PQRS. A line-segment joining opposite vertices (P and R or Q and S) of the quadrilateral is called a **diagonal** of the quadrilateral.

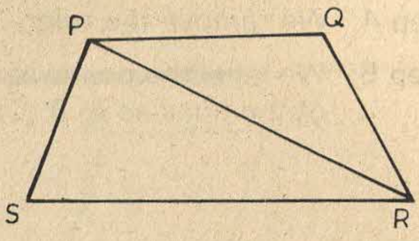


A quadrilateral has two diagonals.

Each of the following figures is a quadrilateral:



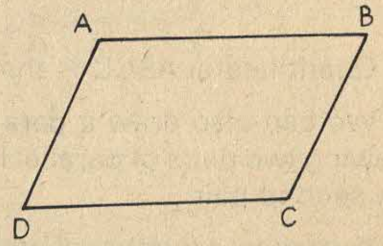
If we draw a diagonal say PR of a quadrilateral PQRS, we get two triangles— ΔPSR and ΔPQR. Therefore, the sum of the four angles of a quadrilateral is 180° + 180°, i.e., 360° (Why.)



Let us now study some special types of quadrilaterals.

I. Parallelogram

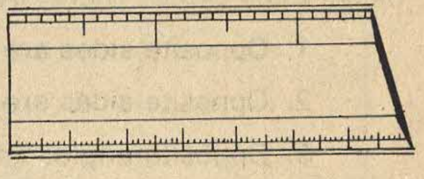
Here is a quadrilateral ABCD such that AB || DC and AD || BC. It is a Parallelogram.



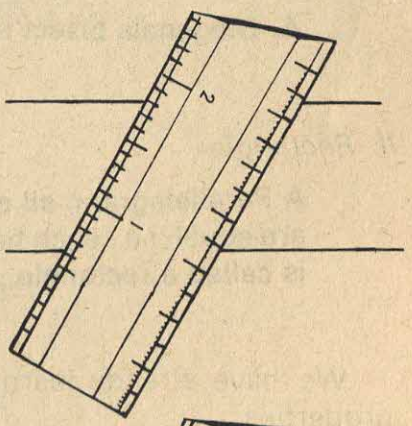
A quadrilateral whose opposite sides are parallel is called a parallelogram.

We can easily draw a parallelogram with the help of the ruler as follows:

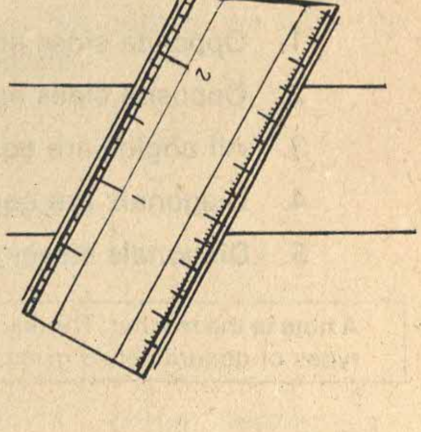
Step 1: We draw two parallel lines by drawing lines along the two edges of the ruler.

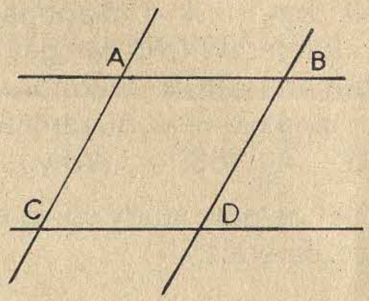


Step 2: We lift our ruler and place it in another position. (See the figure on the right.)



Step 3: We draw again two parallel lines by drawing lines along the two edges of the ruler in the second position.





Step 4: We remove the ruler.

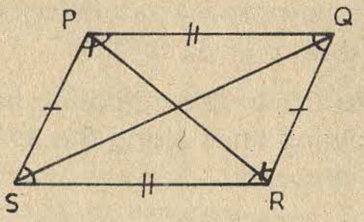
Step 5: We label the points of intersection of the lines as A, B, C, D,

Quadrilateral ABCD is the required parallelogram.

We can also draw a parallelogram with the help of the ruler and set-square by drawing two pairs of parallel lines so that the lines of the first pair intersect the lines of the second pair.

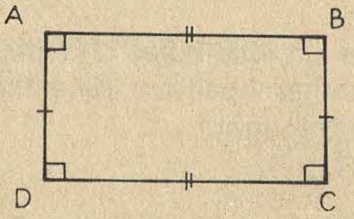
If we draw a number of parallelograms and measure their sides and angles, we find that in each case opposite sides are equal, opposite angles are equal and diagonals bisect each other. Therefore, a parallelogram has the following properties:

1. **Opposite sides are parallel.**
2. **Opposite sides are equal.**
3. **Opposite angles are equal.**
4. **Diagonals bisect each other.**



II. Rectangle

A Parallelogram, all of whose angles are equal, i.e., each has measure 90°, is called a rectangle.



We have already learnt some properties of a rectangle. It has the following properties:

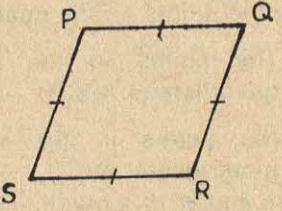
1. **Opposite sides are parallel.**
2. **Opposite sides are equal.**
3. **All angles are equal and each has measure 90°.**
4. **Diagonals are equal.**
5. **Diagonals bisect each other.**

A note to the teacher: The teacher should ask the student to verify all the properties in case of all types of quadrilaterals given in this unit by actual measurement.

III. Rhombus

A parallelogram, all of whose sides are equal, is called a rhombus.

It can be verified easily that if we draw the two diagonals of a rhombus, they bisect each other at right angles. In other words, each is the right bisector of the other.



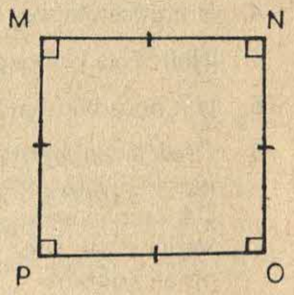
A rhombus has the following properties:

1. **Opposite sides are parallel.**
2. **All sides are equal.**
3. **Opposite angles are equal.**
4. **Diagonals are the right bisectors of each other.**

IV. Square

A parallelogram, all of whose sides are equal and all of whose angles are equal (i.e., each equals 90°), is called a square.

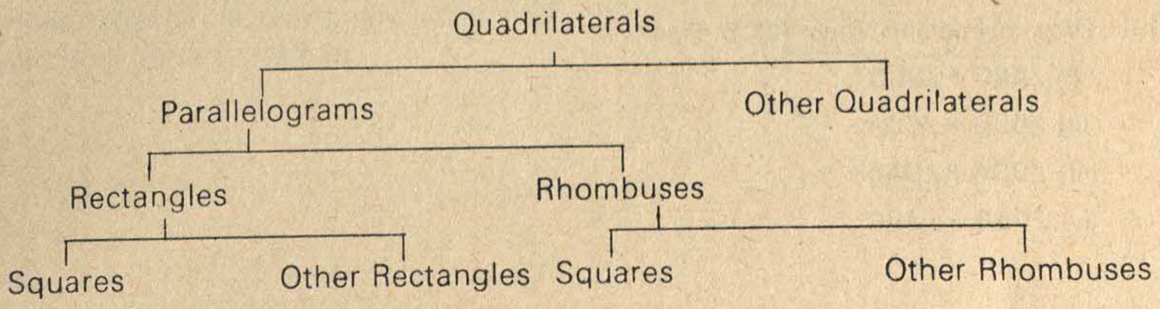
Obviously, a square is also rhombus since all of its sides are equal and a square is also a rectangle since all of its angles are equal.



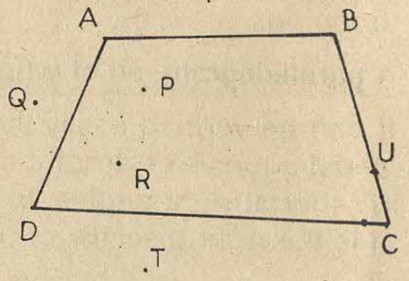
A square has the following properties:

1. **Opposite sides are parallel.**
2. **All sides are equal.**
3. **All angles are equal and each has measure 90°.**
4. **Diagonals are equal.**
5. **Diagonals are the right bisectors of each other.**

In view of the above types of quadrilaterals and their properties, we have the following diagram relating to various types of quadrilaterals:

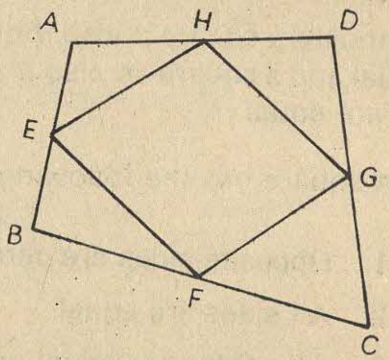


EXERCISE 8(ii)



1. With reference to the figure drawn here name
   (i) the points on the quadrilateral ABCD.
   (ii) The points in the interior of the quadrilateral ABCD.
   (iii) the points in the exterior of the quadrilateral ABCD.
2. Three angles of a quadrilateral are 110°, 95° and 55°. Find the fourth angle.
3. Can a quadrilateral have
   (i) all obtuse angles?
   (ii) all acute angles?
   (iii) all right angles?
4. Is it possible that all the sides and one diagonal of a quadrilateral are equal?

   [Hint: This will happen if a diagonal divides the quadrilateral into two equilateral triangles.]
5. Is it possible that all the sides and both the diagonals of a quadrilateral are equal?
6. Draw any quadrilateral ABCD. Mark the mid-points E, F, G and H of sides AB, BC, CD and DA respectively. Join EF, FG, GH and HE. Verify that the quadrilateral EFGH is a parallelogram.



7. Write down two properties of a square which need not be true for a rhombus.
8. Write down two properties of a square which need not be true for a rectangle.
9. Draw a rhombus with the help of your ruler and pencil only. Draw its diagonals. Verify that each diagonal bisects opposite angles.
10. Draw any parallelogram ABCD. Draw its diagonal BD. Measure angles ABD, BDC, ADB and CBD. Is $\angle ABD = \angle BDC$?

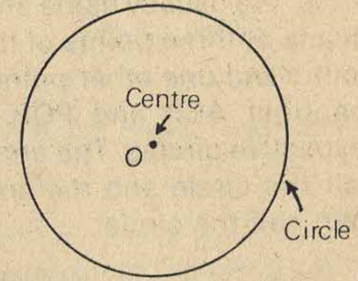
    $\angle CBD = \angle ADB$?
11. Draw any parallelogram ABCD. Find
    (i) $\angle ABC + \angle BCD$
    (ii) $\angle BCD + \angle CDA$
    (iii) $\angle CDA + \angle DAB$
    (iv) $\angle DAB + \angle ABC$

*12. Draw a rectangle ABCD such that AB = 4 cm and AC = 5 cm.

[Hint: Draw a line-segment AB of length 4 cm. At B draw a ray perpendicular to AB. With A as centre and radius equal to 5 cm draw an arc intersecting the ray in point C.]

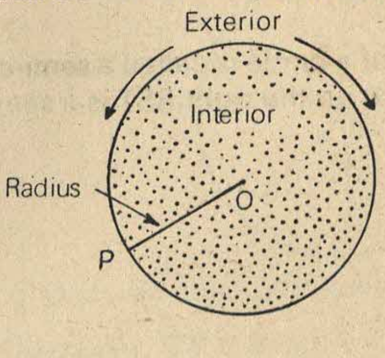
13. Which of the following statements are true?
    - (i) The sum of all the angles of a rhombus is 360°.
    - (ii) A square is not a parallelogram.
    - (iii) Opposite angles of every quadrilateral are equal.
    - (iv) Every rhombus whose diagonals are equal is a square.
    - (v) $\angle A + \angle B$ of any parallelogram ABCD equals 180°.

8.7 Circles

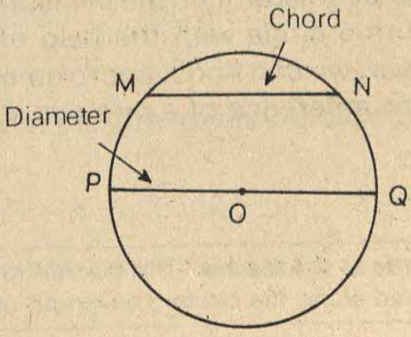


Circle is one of the most useful geometric figures. All wheels, pipes, gears, etc., are circular. Without circular objects there would be no life worth living since transport, industry, communications, agriculture would all come to a close.

We have already learnt about circles in Class IV. We draw a circle with the help of compasses. We fix the sharp end of the compasses on a point, say O, and move the pencil point around. The figure drawn is that of a **circle**. The fixed point (here O) is called the **centre** of the circle.



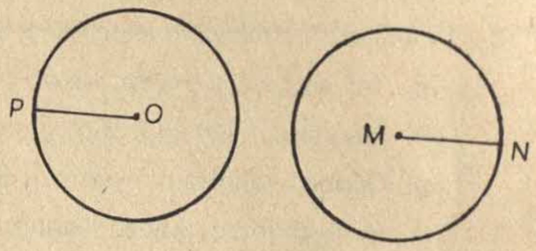
The line-segment joining the centre of a circle to any point on the circle is called the **radius** of the circle. In the figure drawn on the right OP is a radius of the circle. All radii of a circle are equal. The **interior** of the circle has been shaded in the figure on the right. A circle divides the points of the plane into three parts—its interior, circle itself and its exterior.



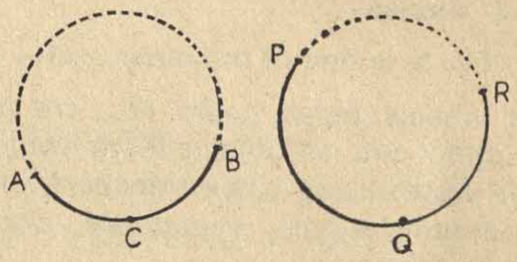
A line-segment (such as PQ) whose end points are points on a circle and which contains the centre of the circle, is called a **diameter** of the circle. Obviously, **a diameter of a circle is twice its radius.**

A line-segment joining any two points on a circle is called a **chord** of the circle. Clearly, a diameter is also a chord of the circle. As a fact, diameter is the greatest chord of a circle.

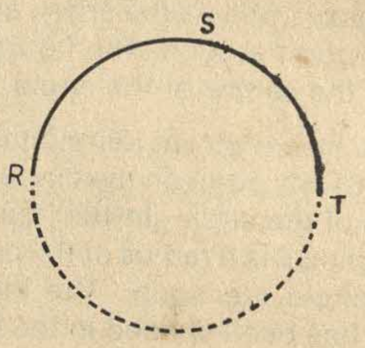
Two circles are said to be **equal** if their radii are equal. Here the two circles are equal as OP = MN.



Any part of a circle is called an **arc** of the circle. We usually name an arc of a circle by means of three points of the arc — two end points and one other point. In the figure on the right ACB and PQR are arcs of the respective circles. The arc ACB is less than half the circle and the arc PQR is greater than half the circle.



Half of a circle is called a **semi-circle.** In the figure on the right RST is a semi-circle.



The perimeter (i.e., the measure) of a circle is called its **circumference.** We cannot measure a circle with the help of a ruler the way we can measure a line-segment. However, we can find it approximately with the help of a thread. It can be verified that the circumference of a circle is slightly more than three times its diameter.

A note to the teacher: The teacher must ask and help the students to draw a circle and put a thread along the circle. The length of the thread will give the circumference of the circle.

Let us now perform the following activities:

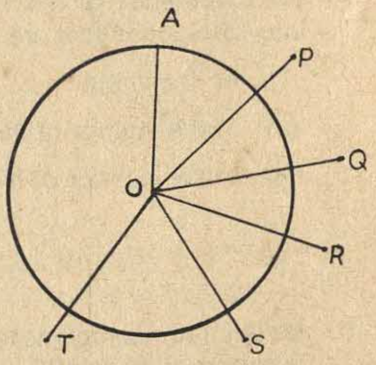
Activity 1

(i) We draw a circle of radius 4 cm with the centre O.

(ii) We mark 5 points P, Q, R, S and T in the exterior of the circle.

(iii) We join OP, OQ, OR, OS and OT and measure each of them.

(iv) We draw a radius OA. Obviously OA = 4 cm.



(v) We compare the measure of each of OP, OQ, OR, OS and OT with that of OA.

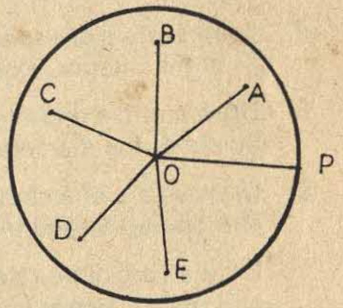
We conclude:

A line-segment joining the centre and any point in the exterior of a circle is greater than the radius of the circle.

Activity 2

(i) We draw a circle of radius 6 cm with the centre O.

(ii) We mark five points A, B, C, D and E in the interior of the circle.



(iii) We join OA, OB, OC, OD and OE and measure each of them.

(iv) We draw a radius OP of the circle. Obviously, OP = 6 cm.

(v) We compare the measure of each of OA, OB, OC, OD and OE with that of OP.

We conclude:

A line-segment joining the centre and any point in the interior of a circle is less than the radius of the circle.

Thus, if O is the centre of a circle and A a point in the plane of the circle. Then

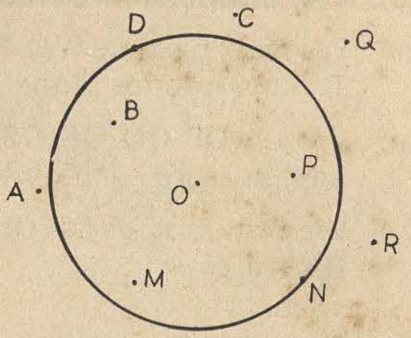
(i) 'OA > radius' implies that A is in the exterior of the circle.

(ii) 'OA = radius' implies that A is on the circle itself.

(iii) 'OA < radius' implies that A is in the interior of the circle.

EXERCISE 8(iii)

1. Draw a circle whose diameter is 6.8 cm.
2. With reference to the figure on the right, state the points that are
   (i) on the circle.
   (ii) in the interior of the circle.
   (iii) in the exterior of the circle.



3. Mark three non-collinear (not all in a line) points A, B and C. Join AB and BC. Draw the right bisectors of AB and BC. Label the point of intersection as O. With centre O and radius OA draw the circle. Does it pass through B? Through C?
4. Draw a circle of any radius. Draw its two diameters that are perpendicular bisectors of each other.
5. Draw a circle of any radius and draw one of its chords. Draw the perpendicular bisector of the chord. Does it pass through the centre of the circle?
6. Draw a circle of radius 8 cm. Mark a point at distance 10 cm from the centre. Is the point in the interior of the circle?
7. Draw a circle of a radius 5 cm. Mark a point at distance 4 cm from the centre. Where is the point — in the interior, exterior or on the circle?
8. Draw a circle and one of its diameters. Take any point on the circle and join it with the end points of the diameter. Measure the angle sc formed. Is it a right angle?
9. Draw an arc of a circle less than half the circle. Take any point on this arc and join it with the end points. Measure the angle so formed. Is it an obtuse angle?
10. Draw an arc of a circle greater than half the circle. Take any point on this arc and join it with the end points. Measure the angle so formed. Is it an acute angle?
11. Draw a circle of radius 5 cm. Measure its circumference with the help of a thread. Find the ratio of circumference to the diameter.
12. Draw a line-segment AB of length 6 cm. With centre A and radius 2 cm, draw a circle. With centre B and radius 3 cm draw another circle. Do the two circles intersect? Give reasons in support of your answer.
13. Draw a line-segment PQ of length 10 cm. With centre P and radius 6 cm draw a circle. With centre Q and radius 5 cm draw another circle. Do the two circles intersect? If yes, in how many points? Give reasons in support of your answer.
14. Draw a line-segment CD of length 8 cm. With centre C and radius 5 cm draw a circle. With centre D and radius 3 cm draw another circle. Do the two circles intersect? If yes, in how many points? Give reasons in support of your answer.

S.C.E.R.T., West Bengal
Library
Calcutta
25/3, B. C. Road

UNIT IX

MENSURATION

9.1 Review

In Class IV we learnt that the perimeter of a rectangle equals twice the sum of any two adjacent sides. If we call the longer side as length and the shorter side as breadth of the rectangle, we have

Perimeter of a rectangle = 2 × (length + breadth)

Consequently,

Perimeter of a square = 4 × side (Why?)

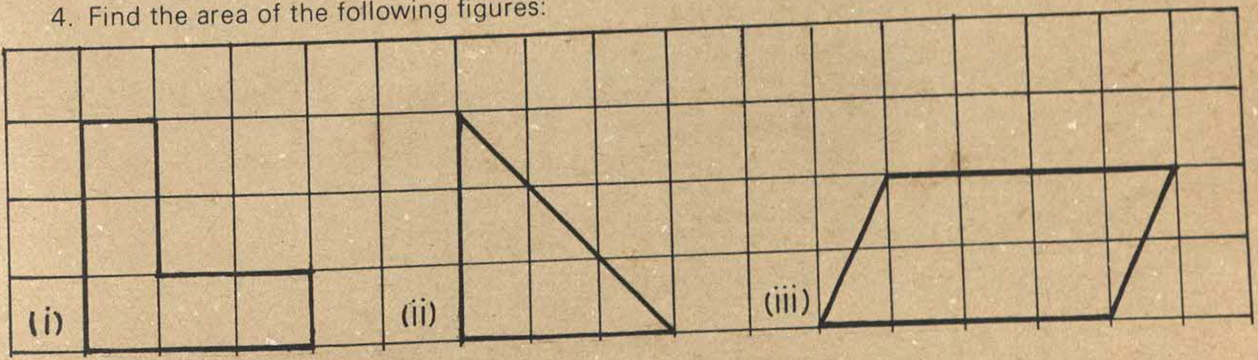
We have also learnt that the area of a region is the number of unit squares contained in it. The units of area most often used are square metre (sq. m)' and 'square centimetre (sq. cm)'. When the length and breadth are expressed in the same units of measure, we have

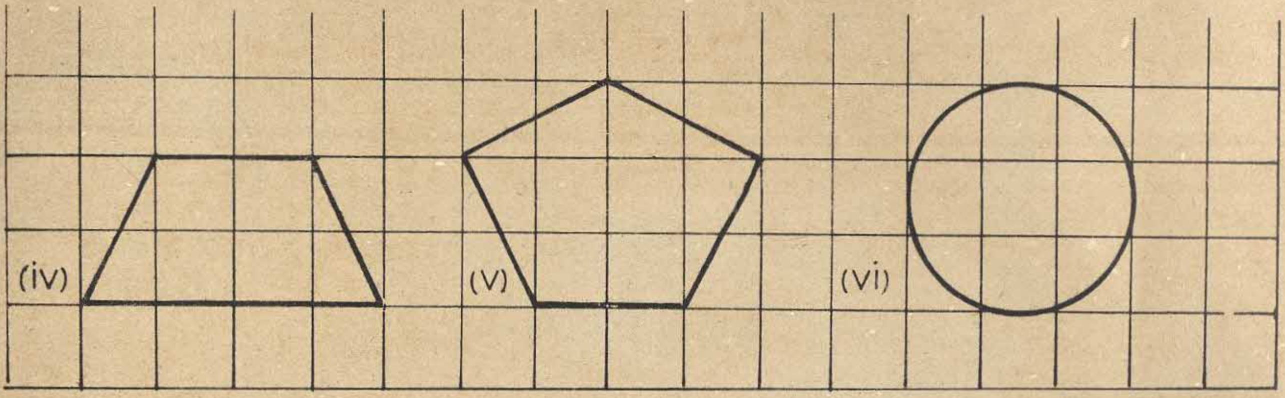
Area of a rectangle = length × breadth

Area of a square = side × side

EXERCISE 9(i)

1. If the length and breadth of a rectangle are 6.5 cm and 3.5 cm, find the perimeter of the rectangle.
2. Find the perimeter of a square whose side is 5.5 cm.
3. Find the cost of fencing a rectangular field of length 22 m and breadth 15 m, if the cost of fencing is Rs 10 a metre.
4. Find the area of the following figures:





5. Find the area of the rectangle whose length and breadth are respectively 1 m 75 cm and 80 cm.
6. Find the area of a square whose side is $2\frac{1}{2}$ cm.
7. Which of the two—a rectangle of length 16 cm and breadth 12 cm or a square of side 14 cm, has more area and by how much more?
8. How many square centimetres together make a square metre?
9. Distinguish between 2 square metres and 2 metre-square.

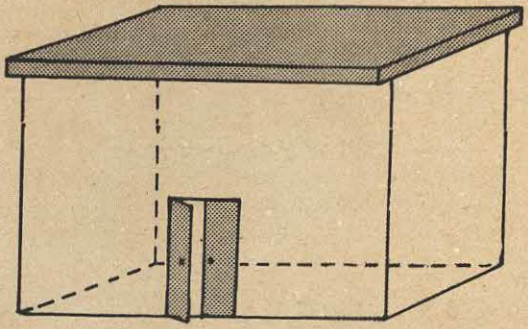
   [**Hint**: 2 metre-square means a square of side 2 m.]
10. A living room is 5.57 m long and 3.25 m wide. Find the area of its floor.
11. A rectangular field measures 400 m by 100 m and a square field 200 m by 200 m.
    (i) Do the two fields have the same area?
    (ii) Which field requires more fencing and by how much more?
12. A tile measures 10 cm × 10 cm. How many such tiles are required to cover a wall 4 m × 2.5 m?
13. Find the number of pieces, each measuring 5 cm by 3 cm that can be cut from a sheet 36 cm by 30 cm. Assume that there is no wastage.
14. How many stamps each measuring 2 cm × 1.5 cm can be pasted on a sheet of paper 12 cm × 6 cm?
15. A person has three flower beds, two of which are 8 m by 5 m and one is 12 m by 3 m. He wants to grow some flower plants in them. Each plant requires an area of 2500 square cm. How many plants can be grown?
16. How many rectangular plots of land 20 m × 10 m can be cut from a square field of side 1 hm?
17. What happens to the area of a rectangle if
    (i) its length is doubled and breadth remains the same.
    (ii) its length is doubled and breadth is halved.
    (iii) its length and breadth are both doubled.

*18. The area of a square is 36 sq cm. Find the perimeter of the square.

[**Hint**: $6 \times 6 = 36$]

9.2 Area of the Four Walls of a Room

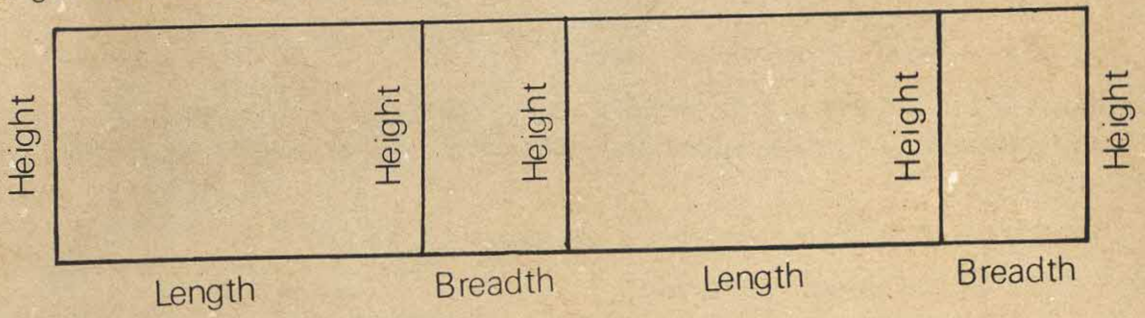
In a rectangular room, all walls have the same height. Opposite walls have the same length and hence the same area. See the picture of the room given below:



Room

The length of either of the longer walls of the room is called the length of the room. The length of either of the shorter walls of the room is called its breadth.

To find the area of the four walls, we can imagine that the four walls are placed in a straight row as shown below:



We can, then, simply find the area of each wall and add. Thus,

Area of the four walls of a room

= (length × height) + (breadth × height) + (length × height) + (breadth × height)

= 2 × (length × height) + 2 × (breadth × height)

= 2 × height × (length + breadth) (Why?)

i.e., **Area of the four walls = 2 × height × (length + breadth)**

A note to the teacher : The teacher must indicate that before using the above result to find the area of the four walls of a room, the measures of length, breadth and height must be expressed in the same units. He should also tell that the area of a wall means the area of one side of the wall. If one or more walls of a room contain doors, windows, etc., the total area of all the doors, windows, etc. is to be subtracted from the total area of the four walls of the room to get the exact area of the walls.

Example 1 : A school room is 11 m long, 8 m wide and 5 m high. Find the area of its floor and the four walls.

Solution : The two edges of the floor are the length and the breadth of the room.

Therefore, the area of the floor = length × breadth

= (11 × 8) square m

= 88 sq. m

Area of the fours walls

= 2 × height × (length + breadth)

= 2 × 5 × (11 + 8) sq. m

= 2 × 5 × 19 sq. m

= 190 sq. m

Example 2: The length, breadth and height of a closed wooden box are 1.5 m, 1.2 m and 1.2 m respectively. Find the cost of painting the whole outer surface of the box at the rate of Re 1 per square metre.

Solution : The total surface area of the box to be painted is the total surface area of the top and bottom of the box together with the total surface area of the four side-walls of the box.

The total surface area of the top and bottom of the box

= 2 × (length × breadth) (Why?)

= 2 × 1.5 × 1.2 sq. m

= 3.60 sq. m

The total surface area of the four side-walls of the box

= 2 × height × (length + breadth)

= 2 × 1.2 × (1.5 + 1.2) sq. m

= 6.48 sq. m

Total surface area of the box to be painted

= (3.60 + 6.48) sq. m

= 10.08 sq. m

The cost of painting the outer surface of the box

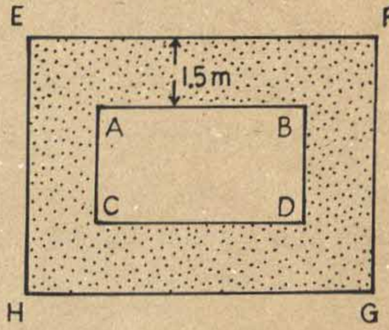
= Rs (10.08 × 1)

= Rs 10.08

9.3 Area of Paths

The concept of area of a rectangle is also used to determine the area of path(s) running around or cutting across at right angles inside a field, garden or park. We are often interested to know how much land has been exactly utilised for planting, etc. For this we have to calculate the area of land covered in paths. Let us study the following illustrative examples:

Example 3: A path 1.5 m wide is running around a rectangular plot of grass 20 m by 12 m. Determine the area of the path and the money needed for tiling it at the rate of Rs 7.50 per square metre.



Solution: Let us represent the rectangular plot of grass by the rectangle ABDC drawn here. In the figure, the path around has been shaded. Obviously, area of the path = area of the rectangle EFGH − area of the rectangle ABDC.

Now, EF = AB + 1.5 m + 1.5 m (Why?)

= 20 m + 1.5 m + 1.5 m

= 23 m

Similarly, FG = 12 m + 1.5 m + 1.5 m

= 15 m

Therefore, area of path

= (23 × 15) sq. m − (20 × 12) sq. m

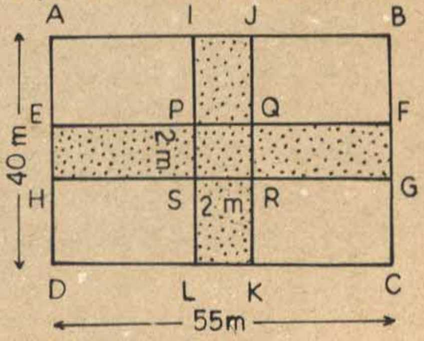
= 345 sq. m − 240 sq. m

= 105 sq. m

Cost of tiling = Rs (105 × 7.50).

= Rs 787.50

Example 4 : Two paths, each two metres wide, run at right angles through the centre of a rectangular park 55 m by 40 m. Find the space of the park left for planting, etc.



Solution: Let, in the figure on the right, ABCD represents the park and the rectangles. EFGH and IJKL represent the two paths which run at right angles through the centre of the park.

Area of the path EFGH = 55 × 2 sq. m

= 110 sq. m

Area of the path IJKL = 40 × 2 sq. m

= 80 sq. m

To get the total area of the two paths, we note that the common area PQRS (2 m × 2 m) has been included in both the areas of the two paths EFGH and IJKL. Therefore, we need to subtract its area from the total area of the paths EFGH and IJKL.

Thus, the area of the two paths = (110 + 80 − 4) sq. m

= 186 sq. m

Now, the total area of the park = (55 × 40) sq. m

= 2200 sq. m

Hence, the space left for planting, etc.

= (2200 − 186) sq. m

= 2014 sq. m

EXERCISE 9(ii)

1. Find the area of the four walls of a room whose dimensions are
   - (i) length = 8 m, breadth = 6 m, height = 3 m
   - (ii) length = 6 m, breadth = 4 m, height = 3.5 m
   - (iii) length = 4.5 m, breadth = $4\frac{1}{2}$ m, height = 3.2 m
2. A hall is 15 m long, 8 m wide and 5 m high. Its walls and roof are to be white-washed from inside. Find the total area to be white-washed.
3. A swimming pool is 20 m in length, 15 m in breadth and 4 m in depth. Find the cost of cementing its floor and walls at the rate of Rs 5.30 per square metre.
4. The perimeter of the floor of a squared room is 20 m 24 cm. If the height of the room is 3 m 37 cm, find the area of its four walls.
5. A path 3 m wide is running around a square field whose side is 45 m. Determine the area of the path.
6. A path 2.5 m wide is running along the inside of the boundary of a rectangular field 110 m by 69 m. The path is to be covered by red sand. The contractor charges Rs 2.85 per square metre for delivering red sand. Determine the charges of the contractor.
7. A rectangular field is 28 m by 16.4 m. Two paths run at right angles through the centre of the field. The longer path is 1.8 m wide and the shorter one is 1.2 m wide. Find the total area of the paths.
8. Find the area of a thin sheet to make an open box (i.e., without a lid) 6 m long, 3.2 m wide and 2.5 m high.
9. Find the area of a card-board used for making a closed box 2.5 m long, 2 m wide and 1.6 m high.

10. A cistern 16 m long and 10 m wide contains water upto a depth of 1.6 m. Find the area of the wet surface.

11. The length, breadth and height of a room are 6 m, 4.4 m and 3.5 m respectively. It contains two doors each of size 2.2 m by 1.2 m and three windows each of size 1.6 m × 1.2 m. Find the cost of oil-painting the four walls of the room at the rate of Rs 2.50 per square metre.

*12. How much high is a room whose length and breadth are 5 m and 4 m respectively and the area of whose four walls is 63 square m?
[**Hint**: Height of the room = area of the four walls ÷ {2 × (length + breadth)}]

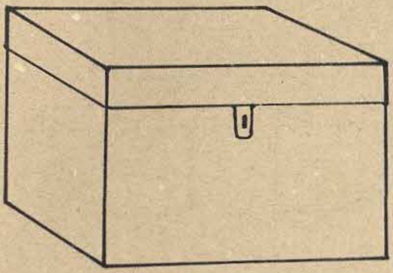
13. A sheet of tin measures 5 m 20 cm by 2 m 10 cm. A strip 15 cm wide is cut off all around. Find the area of the remaining sheet and also the area of the sheet cut.

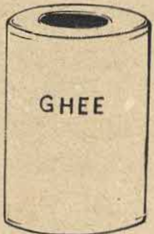
14. A rectangular field 30 m by 25 m is enlarged by digging a strip 3.5 m wide all around it. Find the perimeter and the area of the enlarged field and also the area of the strip.

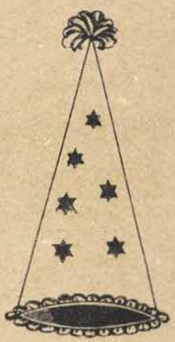
15. A photograph 8 cm long and 5 cm wide is mounted on a card so that there is a margin of 1 cm wide at the top and bottom and 0.80 cm wide along each of the sides. Find the total area of the margin left.

9.4 Measurement of Solids—Concept of Volume

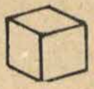
We are familiar with common solids. Here are some solids.







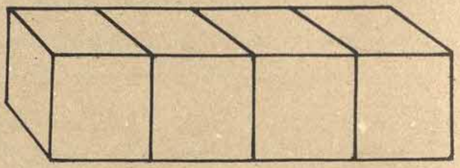
So far we have learnt how to measure line-segments and plane regions. Here, we shall learn to measure rectangular solids (cuboids and cubes only).

We recall that we measure a line-segment by a unit line-segment and see how many such unit line-segments are contained in the given line-segment. The number of these unit line-segments gives us the measure (called length) of the given line-segment. We measure a region in terms of unit regions and see how many such unit regions together make the given region. The number of these unit regions gives the measure (called area) of the given region. Similarly we measure a solid (the portion of space it occupies) in terms of a unit of solid which is a cube () of side 1 mm, 1 cm or 1 m, etc. The number of such unit cubes which together make the given solid gives the measure (called **volume**) of the solid. Thus, we see that the volume of a solid gives the measure of the amount of space which it occupies. The inner space of a hollow solid is called its **capacity**.

9.5 Building Cuboids and Cubes with the Help of Unit Cubes

To measure the space occupied by a rectangular solid we count the unit cubes contained by the solid. The total number of unit cubes gives us the volume of the solid. To determine the volume of a cuboid, let us perform the following experiments:

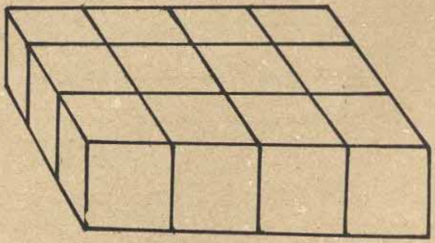
> **A note to the teacher**: The teacher must practically demonstrate each of the following experiments with the help of wooden cubical blocks or plastic cubes.



(i) Let us put 4-unit cubes in a row. (See the figure on the right.) We get a cuboid whose length, breadth and height are 4, 1 and 1 units respectively. (Why?)

The volume of the cuboid thus formed is obviously 4-unit cubes.

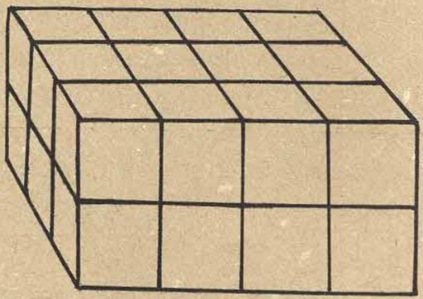
We note that 4 × 1 × 1 = 4



(ii) We now put two more rows each of 4 cubes along the previous one. (See the figure on the right.) The figure formed is again that of a cuboid whose length, breadth and height are 4, 3 and 1 units respectively. (Why?)

The volume of this cuboid is obviously 12-unit cubes.

We note that 4 × 3 × 1 = 12



(iii) We now put a layer of 12 cubes over the cuboid formed in (ii) above. (See the figure on the right.) We again get a cuboid whose length, breadth and height are 4, 3 and 2 units respectively. (Why?)

The volume of this cuboid is 12 + 12, i.e., 24-unit cubes.

We note that 4 × 3 × 2 = 24

Let us now prepare a table for the above experiments to know the volume of each.

Experiment	Length	Breadth	Height or thickness	Volume, i.e., number of unit cubes	Length × breadth × height
(i)	4	1	1	**4**	4 × 1 × 1 = **4**
(ii)	4	3	1	**12**	4 × 3 × 1 = **12**
(iii)	4	3	2	**24**	4 × 3 × 2 = **24**

We find that in each case the 'length × breadth × height' gives the volume of the cuboid. Therefore, we conclude:

If the length, breadth and height of a cuboid are expressed in the same unit of measure, the volume of a cuboid = length × breadth × height.

We recall that every cube is also a cuboid whose length, breadth and height are the same, i.e., equal to its edge or side. Therefore,

Volume of a cube = side × side × side

Since the volume of a solid is in terms of unit cubes, we write 'cubic cm' with the volume of the solid if the unit cube used is a cube of 1 cm; we write 'cubic m' with the volume of the solid if the unit cube used is a cube of 1 m; and so on. Let us study the following examples:

Example 5: Find the volume of a box 12 cm by 8 cm by 5 cm.

Solution: Here, length = 12 cm, breadth = 8 cm and height = 5 cm.

Hence, volume = 12 × 8 × 5 cubic cm
= 480 cubic cm

Example 6 : How many bricks of size 24 cm by 12 cm by 8 cm are required to construct a wall 9 metres long 4 metres high and 36 cm thick?

Solution : Volume of a brick = (24 × 12 × 8) cubic cm

Volume of the wall = (900 × 400 × 36) cubic cm

Number of bricks required

$$= \frac{900 \times 400 \times 36}{24 \times 12 \times 8}$$

$$= 5625$$

Example 7: Find the volume of wood in a closed wooden box whose inside and outside dimensions are 25 cm by 20 cm by 16 cm and 27 cm by 22 cm by 18 cm respectively.

Solution : Volume of the wood

= Outer volume of the box – inner volume of the box

= (27 × 22 × 18) cubic cm – (25 × 20 × 16) cubic cm

= 10692 cubic cm – 8000 cubic cm

= 2692 cubic cm

Example 8 : How many cubic centimetres are there in a cubic metre?

Solution : 1 metre = 100 centimetres

Let us consider a cube of side 1 m and find how many cubic centimetres it contains.

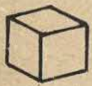
Volume of the cube of side 1 m

= (100 × 100 × 100) cubic cm

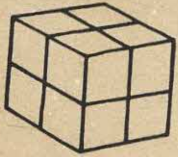
= 1000000 cubic cm

Therefore, 1 cubic m = 1000000 cubic cm

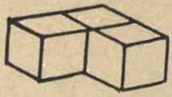
EXERCISE 9(iii)

1. If  is the unit of volume, find the volume of each of the following figures:

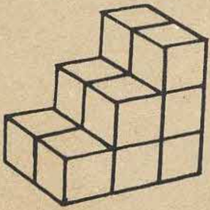
(i)



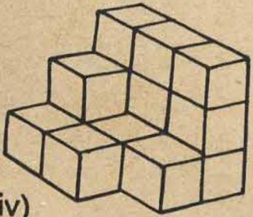
(ii)



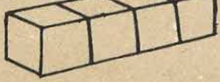
(iii)



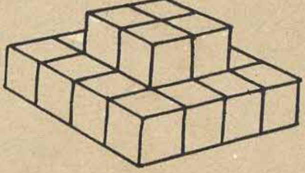
(iv)



(v)



(vi)



2. Find the volumes of the rectangular solids whose dimensions are as follows:
   - (i) Length 15 cm, width 10 cm, height 5 cm
   - (ii) Length 20.5 cm, width 7.5 cm, height 3 cm
   - (iii) Length 12 m, breadth 9 m, thickness 80 cm
   - (iv) Length $12\frac{1}{2}$ m, breadth 6.2 m, thickness 75 cm

3. A packet full of tea is 10 cm in length 6 cm in width and 4 cm in height. Determine the quantity of tea in the packet.

4. A petrol tank is 1.5 m long, 1.5 m wide and 30 cm high. Find the quantity (in litres) of petrol it can hold. (1000 cubic cm = 1 litre)

5. A water tank is 3 m long, 2 m broad and 1.5 m deep. How much water (in litres) can it hold?

6. Find the volume of each of the following objects:

   (i) Match box: length 5 cm, breadth 3.5 cm, height 1 cm
   (ii) Book : length 22.5 cm, breadth 10.5 cm, height 4.5 cm
   (iii) Brick: length 22.5 cm, breadth 10 cm, height 7.5 cm
   (iv) Chalk-box: length 6.5 cm, breadth 6.5 cm, height 6.5 cm

7. The length, breadth and height of a room are 4 m, 3.5 m and 3 m respectively. Find the volume of air it contains.

8. The floor of a tank is a rectangle 3.5 m by 2 m. Find the volume of water in cubic metres upto a depth of 80 cm from the floor.

9. A labourer digs a rectangular pit 5.5 m long 2 m broad and 1.5 m deep. How much earth is dug out by him?

10. A wooden door is 2.25 m in length, 1 m in breadth and 2.5 cm in thickness. Find the volume of wood used in it.

11. A soap-cake measures 7 cm×5 cm×2.5 cm. How many soap-cakes can be placed in a card-board box 56 cm by 40 cm by 25 cm?

*12. A rectangular tank $4\frac{1}{2}$ m long, 2.64 m wide contains water upto a depth of 1.95 m. The water is transferred to an empty tank 6 m long and 3 m wide. Find the depth of water in the new tank.

13. The weight of a metal block of size 10 cm by 8 cm by 6 cm is 9 kg. Find the weight of a block of the same metal of size 20 cm by 4 cm by 3 cm.

14. How many rectangular pieces of wood of size 25 cm by 20 cm by 10 cm can be cut from a log of wood of size 3 m by 1 m by 50 cm, if there is no waste?

15. A swimming pool is 250 m long and 120 m wide. How many kilolitres of water must be pumped into it so as to raise the level of water by 5 cm? (1000 cubic cm = 1l)

UNIT X

PER CENTS

10.1 Meaning of Per Cent

In our daily life we come across a number of situations of the following type:

> "Gopal got 18 marks out of 25 in Mathematics and 14 marks out of 20 in Science. He wants to know in which subject (Mathematics or Science) his performance was better."

We can express marks of Gopal in each subject as a fraction of 1. We, thus, get

$\frac{18}{25}$ marks out of 1 mark in Mathematics,

$\frac{14}{20}$ marks out of 1 mark in Science.

We can, now, compare $\frac{18}{25}$ and $\frac{14}{20}$.

$\frac{18}{25} > \frac{14}{20}$ since $18 \times 20 > 14 \times 25$

We, thus, find that Gopal's performance in Mathematics was better.

We could also compare $\frac{18}{25}$ and $\frac{14}{20}$ by converting these fractions into equivalent fractions with common denominator 100.

$$\frac{18}{25} = \frac{18 \times 4}{25 \times 4} = \frac{72}{100}$$

$$\frac{14}{20} = \frac{14 \times 5}{20 \times 5} = \frac{70}{100}$$

Obviously, $\frac{72}{100} > \frac{70}{100}$. We, therefore, get the same conclusion that Gopal's performance in Mathematics was better.

When we compare two quantities by converting each as a part of 100, we use the word **per cent.** We say "Gopal got '72 out of 100', i.e., '72 per cent', marks in Mathematics and '70 out of 100', i.e., '70 per cent' marks in Science."

The word 'per cent' is derived from the Latin 'per centum' meaning 'hundredth' or 'for every hundred'. We use the symbol '%' for per cent. Thus,

$$72 \text{ per cent} = 72\% = \frac{72}{100}$$

$$70 \text{ per cent} = 70\% = \frac{70}{100}$$

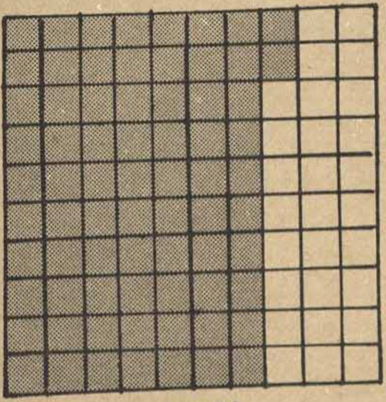
Also,

$$72\% = \frac{72}{100} = 72 \times \frac{1}{100} \qquad \text{(Why?)}$$

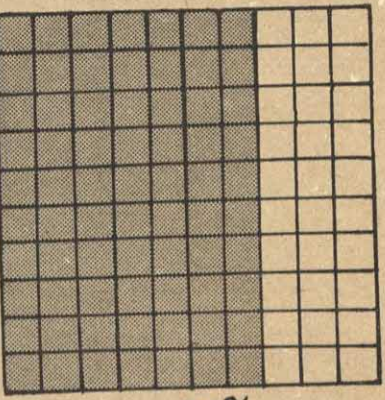
$$70\% = \frac{70}{100} = 70 \times \frac{1}{100}$$

The symbol % stands for $\frac{1}{100}$

The shaded parts of the following two figures represent 72% and 70% of the whole respectively:



72%



70%

The use of per cent makes comparison easier. Most often it is just like comparing whole numbers. Since 72 > 70, we conclude that Gopal's performance in Mathematics was better.

10.2 To Convert Common Fractions into Per Cents

To convert a common fraction into per cent, we convert it into equivalent fraction with denominator 100. Thus,

$$\frac{3}{4}=\frac{3\times 25}{4\times 25}=\frac{75}{100}=75\%$$

Alternatively,

$$\frac{3}{4}=\left(\frac{3}{4}\times 100\right)\times\frac{1}{100} \qquad \text{(Why?)}$$

$$=\left(\frac{3}{4}\times 100\right)\%=75\%$$

Therefore,

To convert a common fraction into per cent, we multiply the fraction by 100 and insert % symbol.

Example 1: Convert each of the following fractions into per cent:

(i) $\frac{1}{2}$ (ii) $\frac{2}{3}$ (iii) $2\frac{2}{5}$

Solution :

(i) $\frac{1}{2}=\left(\frac{1}{2}\times 100\right)\%$

$= 50\%$

(ii) $\frac{2}{3}=\left(\frac{2}{3}\times 100\right)\%$

$=\frac{200}{3}\%$

$= 66\frac{2}{3}\%$

(iii) $2\frac{2}{5}=\left(\frac{12}{5}\times 100\right)\%$

$=240\%$

A note to the teacher: The teacher must point out that a per cent may be greater than 100. For example,

$300\% = \frac{300}{100} = 3,$ $\qquad 256\% = 2.56$, etc.

10.3 To Convert Per Cents into Common Fractions

Let us concentrate on the following per cents and convert each into a common fraction:

(i) $25\% = 25 \times \frac{1}{100}$ (Why?)

$= \frac{1}{4}$

(ii) $130\% = 130 \times \frac{1}{100}$

$= \frac{13}{10}$

$= 1\frac{3}{10}$

(iii) $\frac{22}{3}\% = \frac{22}{3} \times \frac{1}{100}$

$= \frac{11}{150}$

We conclude:

To convert a per cent into a common fraction, we multiply the given number indicating per cent by $\frac{1}{100}$ and simplify the resulting fraction.

10.4 To Convert Decimals into Per Cents

Let us consider the following decimals and convert each into per cent:

(i) $0.125 = (0.125 \times 100)\%$

$= 12.5\%$

How many places to the right is the decimal point shifted?

(ii) $0.35 = (0.35 \times 100)\%$

$= 35.0\%$

$= 35\%$

How many places to the right is the decimal point shifted?

We conclude:

To convert a decimal into per cent we move the decimal point two places to the right and insert % symbol.

10.5 To Convert Per Cents into Decimals

Let us convert some per cents into decimals and try to find the rule.

(i) $36\% = \frac{36}{100} = 0.36$

We note that $36 = 36.0$. How many places to the left is the decimal point shifted?

(ii) $$\begin{aligned} 17.5\% &= 17.5 \times \frac{1}{100} \\ &= \frac{175}{10} \times \frac{1}{100} \\ &= \frac{175}{1000} \\ &= 0.175 \end{aligned}$$

How many places to the left is the decimal point shifted?

(iii) $$\begin{aligned} 220.9\% &= 220.9 \times \frac{1}{100} \\ &= \frac{2209}{10} \times \frac{1}{100} \\ &= \frac{2209}{1000} \\ &= 2.209 \end{aligned}$$

How many places to the left is the decimal point shifted?

We conclude:

To convert a per cent into decimal we move the decimal point two places to the left and remove % symbol.

EXERCISE 10(i)

1. Convert each of the following fractions into per cent:

(i) $\frac{1}{20}$ (ii) $\frac{3}{5}$ (iii) $\frac{1}{4}$

(iv) $\frac{9}{20}$ (v) $\frac{3}{10}$ (vi) $\frac{4}{25}$

(vii) $\frac{7}{8}$ (viii) $\frac{5}{16}$ (ix) $1\frac{7}{8}$

(x) $2\frac{9}{20}$ (xi) $4\frac{1}{3}$ (xii) $33\frac{1}{3}$

2. Convert each of the following per cents into common fraction or mixed number in the lowest form:

(i) 15%
(ii) 36%
(iii) 21%
(iv) 55%
(v) 75%
(vi) 80%
(vii) 110%
(viii) 225%
(ix) 350%
(x) 144%
(xi) 650%
(xii) 100%

3. Convert each of the following decimals into per cent:

(i) 0.256
(ii) 1.712
(iii) 36.52
(iv) 16.4
(v) 9.8
(vi) 0.02
(vii) 0.006
(viii) 1.205
(ix) 6.083
(x) 0.01
(xi) 1.11
(xii) 0.9

4. Convert each of the following per cents into decimal:

(i) 25.3%
(ii) 128.6%
(iii) 998.5%
(iv) 12.5%
(v) 38.0%
(vi) 76%
(vii) 90%
(viii) 1.9%
(ix) 2.5%
(x) 0.1%
(xi) 0.6%
(xii) 9%

10.6 Money and Metric Measures as Per Cents

(i) Since Re 1 = 100 paise, we get

1 paisa = $\frac{1}{100}$ of a rupee = 1 % of a rupee

2 paise = 2% of a rupee, (Why?)

3 paise = 3% of a rupee,

5 paise = 5% of a rupee,

10 paise = 10% of a rupee,

and so on.

(ii) Since 1 m = 100 cm, we get

1 cm = 1% of a metre,

2 cm = 2% of a metre,

3 cm = 3% of a metre,

10 cm = 10% of a metre,

and so on.

(iii) Since 1 kg = 1000 g, we get

$$1\text{ g} = \frac{1}{1000}\text{ kg} = \frac{1}{10} \times \frac{1}{100}\text{ kg} = \left(0.1 \times \frac{1}{100}\right)\text{ kg}$$

= .0.1% of a kilogram.

2 g = .0.2% of a kilogram.

5 g = 0.5% of a kilogram,

10 g = 1.0% of a kilogram, (Why?)

50 g = 5.0% of a kilogram,

200 g = (200 × .1), i.e., 20.0% of a kilogram,

and so on.

(iv) Since 1 l = 1000 ml, we get

1 ml = 0.1% of a litre,

2 ml = 0.2% of a litre,

10 ml = 1.0% of a litre,

100 ml = 10.0% of a litre

750 ml = 75.0% of a litre

and so on.

10.7 To Find the Value of a Given Per Cent of a Given Quantity

Let us consider the following example:

Example 2 : Find 25% of Rs 40.

Solution :

$$25\% \text{ of Rs } 40 = \text{Rs } \left(\frac{25}{100} \times 40\right)$$

$$= \text{Rs } 10$$

Therefore, to find the value of a given per cent of a given quantity, we multiply the given quantity by the fraction or decimal equivalent of the given per cent.

10.8 To Find the Quantity When a Given Per Cent of It is Known

Let us concentrate on the following examples:

Example 3: 5% of what number is 20?

Solution : 5% of the required number = 20

i.e., 5% × required number = 20

Since multiplication and division are inverse operations, we get the corresponding division fact as

$$\text{Required number} = 20 \div 5\%$$

$$= \frac{20}{1} \div \frac{5}{100}$$

$$= \frac{20}{1} \times \frac{100}{5}$$

$$= 400$$

Check : $5\% \text{ of } 400 = \frac{5}{100} \times 400 = 5 \times 4 = 20$

Example 4 : 27% of how many rupees is Rs 72.90?

Solution : 27% of the required number of rupees

= Rs 72.90

27% × (required number of rupees) = Rs 72.90

Required number of rupees = Rs (72.90 ÷ 27%) (Why?)

$$= \text{Rs}\left(72.90 \div \frac{27}{100}\right)$$

= Rs 270

Check : $27\% \text{ of Rs } 270 = \text{Rs } \left(270 \times \frac{27}{100}\right) = \text{Rs } 72.90$

In view of the above we state that

To find the quantity when a given per cent of it is known, we divide the known quantity by the fraction or decimal equivalent of the given per cent.

10.9 To Find What Per Cent One Number Is of Another

We shall discuss the method by means of an example.

Example 5: 8 is what per cent of 40?

Solution : To find the required per cent we shall use the unitary method.

Out of 40 we have 8.

Out of 1 we must have $8 \div 40$, i.e., $\frac{8}{40}$.

Out of 100 we must have $\frac{8}{40} \times 100$, i.e., 20.

Therefore, required per cent is 20, i.e., 8 is 20% of 40.

Check: $20\ \% \text{ of } 40 = \frac{20}{100} \times 40 = 8.$

EXERCISE 10(ii)

1. Convert each of the following as per cent of a rupee:
   (i) 7 paise (ii) 28 paise (iii) 188 paise
2. Convert each of the following as per cent of a metre:
   (i) 18 cm (ii) 60 cm (iii) 120 cm
3. Convert each of the following as per cent of a kilogram:
   (i) 20 g (ii) 120 g (iii) 875 g
4. Convert each of the following as per cent of a litre:
   (i) 50 ml (ii) 125 ml (iii) 905 ml

5. Convert each of the following as per cent of a quintal:

(i) 10 kg (ii) 750 kg (iii) 500 g

6. A quintal is what per cent of a ton?

7. Find the value of

(i) 5% of Rs 5
(ii) 25% of Rs 12
(iii) 15% of Rs 100
(iv) 100% of Re 1
(v) 20% of 1 kg
(vi) 150% of 1 kg
(vii) 65% of 10 kg
(viii) 175% of 2 kg
(ix) 63% of 1 l
(x) 125% of 10 l
(xi) 8 % of a ton
(xii) 80% of a quintal

8. Find the quantity if

(i) 4% of it is 20 kg.
(ii) 9% of it is Rs 72.
(iii) 1% of it is 4 l.
(iv) 25% of it is a ton.
(v) 20% of it is 80 m.
(vi) 40% of it is 60 ml
(vii) $33\frac{1}{3}\%$ of it is 81 g.
(viii) $66\frac{2}{3}\%$ of it is 3 quintals.
(ix) 0.1% of it is 1 cm.
(x) 0.5% of it is 2 mm.

9. (i) 4 is what per cent of 8?
(ii) 6 is what per cent of 18?
(iii) 10 is what per cent of 25?
(iv) 20 l is what per cent of 45 l?
(v) 125 g is what per cent of 750 g?
(vi) 10 m is what per cent of 95 m?

10. Raghunath got 75 marks out of 80 in mathematics. What per cent of the marks did he get?

11. Purushottam made 66 runs out of a total of 330 runs. What per cent of the runs did he make?

12. Alok ate 3 oranges out of 2 dozen oranges. What per cent of the oranges did he eat?

10.10 Applications of Per Cent

We come across a number of situations wherein we use the concept of per cent. Let us categorize these situations as follows:

I. *General Situations*

Example 6 : Anjali secured 280 marks out of 400 in the half-yearly examination and 360 marks out of 500 in the annual examination. In which of the two examinations did she perform better?

Solution : Let us calculate the percentage of marks she got in each examination.

Percentage of marks in the half-yearly examination

$$= \frac{280}{400} \times 100$$
$$= 70$$

i.e., she got 70% marks in the half-yearly examination.

Percentage of marks in the annual examination

$$= \frac{360}{500} \times 100$$
$$= 72$$

i.e., she got 72% marks in the annual examination.

Obviously, her performance in the annual examination was better.

Example 7: The population of a city was 800000 in 1971 and 1200000 in 1981. Determine the per cent increase in population from 1971 to 1981.

Solution : Increase in population from 1971 to 1981

$$= 1200000 - 800000$$
$$= 400000$$

$$\text{Per cent increase} = \frac{400000 \times 100}{800000} = 50$$

i.e., the population increased by 50%

EXERCISE 10(iii)

1. A basket contained 250 oranges. 70% of the oranges were distributed among the students of Class V. How many oranges were left in the basket?
2. Mahesh secured 105 marks out of 150 in English and 146 marks out of 200 in Hindi. In which of these subjects, his performance was better?
3. It is known that Sunita got 60% marks in History. If the aggregate (total) marks were 150, how many marks did she get in History?
4. A class has 28 students. 100% of them went for a picnic. How many went for the picnic?
5. In the first test, Rajesh answered 6 out of 10 questions correctly. In the second test, he answered 18 out of 25 questions correctly. By the use of per cent, determine whether Rajesh performed better or worse in the second test.
6. A basket contained 300 oranges. 75 oranges were distributed in a class. What per cent were left in the basket?
7. In a school, there are 600 students. 125 students went for a picnic. What per cent did not go for the picnic?

8. A team won 12 matches out of 16. What per cent of the matches were lost by the team?
9. The monthly income of a family is Rs 1600. Rs 500 are spent on food, Rs 200 on housing and Rs 150 on clothing. Express the total expenditure on food, housing and clothing in per cent. What per cent of the income is retained by the family for other purposes?
10. Ram got Rs 25 on Diwali. He spent Rs 15 on crackers, Rs 4 on sweets and put the rest in the bank. What per cent of the money did Ram spend and what per cent did he save?
11. There are 632 students in a school. 158 students come to school by school buses and 316 on bicycles. What per cent of the students come to school
    (i) by school buses?
    (ii) on bicycles?
12. In India, in 1977, 14 women members of parliament (M.P.'s) were elected while in 1979, 26 women M.P.'s were elected. Find the per cent increase in women M.P.'s from 1977 to 1979.

    [**Hint**: Increase for 14 women M.P.'s is that of (26 − 14), i.e., 12 women M.P.'s.]
13. A merchant buys goods worth Rs 3000. If from this amount he is allowed a deduction of 5%, what amount will he actually pay?
14. A company pays a bonus of $8\frac{1}{3}$% of the total yearly salary to each of its employees during a year. Determine the amount of bonus received by an employee whose monthly salary had been Rs 1000 for that year.
    [**Hint**: Yearly salary of the employee = Rs 12000.]
15. A company charges $1\frac{1}{4}$ % extra for packing an article for export. Find the packing charges for an article costing Rs 700.
16. A team won 3 matches, lost 1 and 4 ended in a draw. What per cent of the matches did the team win? Lose?
17. The approximate population of India in 1971 was 5480 lakhs and in 1981 was 6850 lakhs. Find the per cent increase in population from 1971 to 1981.

*18. A drum contained 250 litres of kerosene. $2\frac{1}{2}$% of the kerosene was lost through leakage. What per cent of the kerosene remained in the drum?

II. *Profit and Loss*

The money a shopkeeper pays to buy certain goods is called his **cost price (C.P.)** and the money he receives by selling them is called his **selling price (S.P.)**. Let us suppose a shopkeeper buys sugar at Rs 600 per quintal and sells it for Rs 650 per quintal. The shopkeeper in this situation must be happy because he makes a **profit** of Rs 650 − Rs 600, i.e., Rs 50 per quintal.

Businessmen earn their livelihood by means of their profits. Every businessman tries to sell his goods for a price higher than their cost price and thus earn profit. However, sometimes there arise circumstances like reduction of rates, disposing of old stock, etc. when he has to sell his goods for a price lower than their cost price. In such cases he bears a **loss.**

In view of the above, we have:

If S.P. > C.P., Profit = S.P. − C.P.

If C.P. > S.P., Loss = C.P. − S.P.

When the selling price is more than the cost price, we can also write:

S.P. = C.P. + Profit

C.P. = S.P. − Profit

When the cost price is more than the selling price, we can also write:

S.P. = C.P. − Loss

C.P. = S.P. + Loss

Often, a shopkeeper has to bear certain additional expenses such as labour, freight and those for the maintenance of his goods. These overhead charges become a part of his cost price. We, therefore, add such expenses, if there are any, to his cost price. The sum of the two (the exact cost price and the additional expenses) is considered to be the cost price (C.P.) of the goods for the shopkeeper.

By convention, **we always consider and calculate profit or loss on the cost price and never on the selling price.**

Example 8: A shopkeeper bought a table for Rs 210 and sold it for Rs 217. Find his profit or loss per cent.

Solution: Since selling price is more than the cost price, the shopkeeper gets a profit.

Profit = S.P. − C.P.
= Rs 217 − Rs 210
= Rs 7

Since profit or loss is always considered on the cost price, we have:

On Rs 210 the shopkeeper gets a profit of Rs 7.

On Re 1 the shopkeeper gets a profit of Rs $(\frac{7}{210})$.

On Rs 100 the shopkeeper gets a profit of Rs $(\frac{7}{210} \times 100)$,

i.e., Rs $3\frac{1}{3}$.

Therefore, the shopkeeper gets $3\frac{1}{3}$ % profit.

Example 9: The cost price of an article for a shopkeeper is Rs 300. He wants to sell it at a profit of 15%. Find the selling price of the article.

Solution: Profit of 15% means that if the cost price is Rs 100, the selling price is Rs (100 + 15), i.e., Rs 115.

When C.P. is Rs 100, S.P. is Rs 115.

When C.P. is Rs 300, S.P. is Rs $\left(\frac{115 \times 300}{100}\right)$

i.e., Rs 345.

Therefore, the shopkeeper must sell the article for Rs 345.

Example 10: Shyam purchased an ink-bottle for Rs 4. He kept the bottle for a month and then sold it to one of his friends for Rs 3.20. What per cent did he gain or lose?

Solution : Here C.P. = Rs 4, S.P. = Rs 3.20

i.e., C.P. > S.P.

Thus, Shyam loses.

Loss = C.P. − S.P.
= Rs 4 − Rs 3.20
= Rs 0.80

On Rs 4.00 Shyam loses Rs 0.80.

On Rs 100.00 Shyam loses $\left(\frac{80 \times 10000}{400}\right)$ paise, (Why?)

i.e., 2000 paise

= Rs 20

Hence, loss = 20%

Example 11: A cloth merchant sold 4 dozen sarees at Rs 75 each. His profit is Rs 96. Find the cost price of one saree.

Solution: S.P. of 4 dozen (48) sarees = Rs (75 × 48)

= Rs 3600

Therefore, C.P. of 48 sarees

= S.P. − Profit

= Rs 3600 − Rs 96

= Rs 3504

Hence, C.P. of one saree = Rs $\left(\frac{3504}{48}\right)$

= Rs 73

EXERCISE 10(iv)

1. Find the profit or loss in each of the following cases:

   (i) C.P. = Rs 80, S.P. = Rs 84
   (ii) C.P. = Rs 475, S.P. = Rs 495
   (iii) C.P. = Rs 594.75, S.P. = Rs 588.25
   (iv) C.P. = Rs 12000, S.P. = Rs 11980.50
   (v) Initial cost price = Rs 500, additional expenses = Rs 6.25, S.P. = Rs 510
   (vi) Initial cost price = Rs 1000, additional expenses = Rs 10.50, S.P. = Rs 1005

2. Find the selling price in each of the following cases:

   (i) C.P. = Rs 75.20, Profit = Rs 2.95
   (ii) C.P. = Rs 175.20, Profit = Rs 8.75
   (iii) C.P. = Rs 779.80, Loss = Rs 12.95
   (iv) C.P. = Rs 28.50, Loss = Rs 3.90
   (v) Initial cost price = Rs 1200, additional expenses = Rs 7.50, Profit = Rs 11.50
   (vi) Initial cost price = Rs 8975.35, additional expenses = Rs 5.75, Loss = Rs 220

3. Find the cost price in each of the following cases:

   (i) S.P. = Rs 512, Profit = Rs 13
   (ii) S.P. = Rs 277, Loss = Rs 23
   (iii) S.P. = Rs 2729.85, Loss = Rs 310.75
   (iv) S.P. = Rs 45651.60, Profit = Rs 500

4. Find the profit or loss per cent if

   (i) C.P. = Rs 40, S.P. = Rs 42
   (ii) C.P. = Rs 95, S.P. = Rs 114
   (iii) Initial cost price = Rs 19.40, additional expenses = Rs 1.10, S.P. = Rs 24.60
   (iv) Initial cost price = Rs 145.30, additional expenses = Rs 4.70, S.P. = Rs 120.00

5. Copy and complete the blank cells of the following table, where applicable. If nothing is to be filled in a particular cell mark ' —:'

S.P.	C.P.	Profit	Loss	Profit %	Loss %
Rs 25	Rs 20				
	Rs 75		Rs 3		
	Rs 84	Rs 14			
Rs 45		Rs 5			
Rs 80			Rs 5		

6. Dhiraj bought a cricket bat for Rs 83.50. Its cover cost him Rs 3.30. What must he sell the bat with cover for to make a profit of Rs 2.25?

7. Ramesh buys a pen for Rs 8.50. His expenses in selling it will be Rs 1.10. He wants to have a profit of Rs 2. For how much must he sell the pen?

8. Goverdhan purchased 20 dozen bananas for Rs 60. 5 dozen of the bananas were rotten. At what price per dozen must he sell the remaining bananas so that he is neither at a loss nor at a profit?
9. A toy was purchased for Rs 5 and sold for Rs 7. Find the profit per cent.
10. A shopkeeper sold a toy pistol for Rs 6 and made a profit of 20%. Find the cost price of the pistol.
11. A shopkeeper bought an almirah for Rs 850. The transportation charges were Rs 25. If he sold the almirah for Rs 840, find his profit or loss per cent.
12. Sheela purchased a house for Rs 58970 and spent Rs 530 on its *repairs*. At what price must she sell the house to make a profit of 5%?
13. A shoe-dealer paid Rs 94 for a pair of shoes. He sold it at Rs 120. If his overhead expenses are Rs 2 per pair, find his profit per cent.
14. Karim bought 4 dozen pencils at Rs 7.20 a dozen. He sold them for 65 paise each. Find his profit per cent.
*15. Om Prakash sold an article for Rs 852 at a loss of Rs 48. For what price must he have sold it to gain 5%?
*16. Sushma sold her watch for Rs 332 at a gain of Rs 12. For what price must she have sold it to gain 10%?
17. Sudhakar Rao bought oranges at Rs 5 a dozen. He was forced to sell them at a loss of 4%. At what price per piece did he sell the oranges?
*18. Ram purchased an article for Rs 40, sold it to Shyam at a gain of 5%. Shyam, in turn, sold it to Mohan at a loss of 5%. Find the cost price of Mohan.

III. *Simple Interest*

If we reside in a house owned by some one else, we pay some money called rent to the owner for the benefit of using his house. After use, we vacate the house and return it back to the owner. Similarly, when we borrow some money from a lender or a bank or a finance company for a certain period of time, we have to pay, at the end, some additional money together with the borrowed money for the benefit of using his money. The amount of money borrowed is called the **principal.** The additional money, which we pay for the benefit of using the borrowed money, is called **interest**. The word 'interest' is derived from the fact that the lender is interested to lend his money to a borrower to fetch some more money. Similarly when we put our money in a bank, the bank pays us some interest for the benefit of using our money.

The interest is always paid according to an agreement which is in the form of a per cent of the principal for each year's use and is called the **rate of interest.**

A note to the teacher: The teacher should clarify that interests are of two kinds—**simple** and **compound**. If we calculate the interest on the original principal for each year of its use, it is called **simple interest**. However, if every time a year's interest is added to the principal and the interest for the next year is thus calculated on the increased principal, it is called **compound interest**. Here we are concerned with the simple interest only.

The total amount of money, which we return to the lender at the end of the specified period of time, is called the **amount**. Thus,

Amount = Principal + Interest

Example 12: Meena borrows Rs 300 from a friend. She agrees to pay it back after one year together with the interest of 5% per annum*. How much will the interest be? What amount will she pay back after one year?

> **A note to the teacher**: The teacher must explain that interest of 5% per annum means the interest on Rs 100 for 1 year is Rs 5.

Solution: The interest on Rs 100 for 1 year = Rs 5

The interest on Rs 300 for 1 year = Rs $\left(\frac{5}{100} \times 300\right)$

= Rs 15

Amount = Rs 300 + Rs 15
= Rs 315

Example 13 : Vivek lends Rs 700 at 5% per annum. How much interest will he get after 3 years?

Solution : The interest on Rs 100 for 1 year = Rs 5

The interest on Re 1 for 1 year = Rs $\frac{5}{100}$

The interest on Rs 700 for 1 year = Rs $\left(\frac{5}{100} \times 700\right)$

The interest on Rs 700 for 3 years = Rs $\left(\frac{5}{100} \times 700 \times 3\right)$

= Rs 105

Note : We here see that

Principal = Rs 700, Time = 3 years, Rate = 5% per year

Interest = Rs (700 × 3 × 5%), i.e., the product of the principal, rate per cent and time (in years)

---

* 'per annum' means 'per year'.

Therefore,

Interest = Principal × Rate × Time

Where 'rate' is a per cent per annum and 'time' is in years.

Example 14: Geeta borrowed Rs 1500 from a lender at 9% per annum simple interest for 5 years. What amount will she pay to the lender after the specified time?

Solution : Here, principal = Rs 1500, rate = 9% per annum, time = 5 years

$$\begin{aligned}\text{Therefore, interest} &= \text{Rs } (1500 \times 9\% \times 5)\\ &= \text{Rs } \left(1500 \times \frac{9}{100} \times 5\right)\\ &= \text{Rs } 675\\ \text{Hence, amount} &= \text{Rs } 1500 + \text{Rs } 675\\ &= \text{Rs } 2175\end{aligned}$$

Example 15: Neeru borrowed Rs 625 from Kareem at 12% per annum on 5 July, 1981. Find the amount of money Neeru will pay to Kareem on 16 September, 1983 to clear his dues.

> **A note to the teacher** : The teacher must make it clear that while calculating the number of days for the purpose of calculating interest, we count the day (5 July, 1981 in Example 15) on which a sum of money is borrowed and we neglect the day (16 September, 1983 in Example 15) on which the amount is returned back.

Solution: Let us first calculate the number of years for which Neeru made use of the borrowed money.

5 July, 1981 to 4 July, 1983 (including 4 July, 1983) = 2 years

Remaining number of days of July, 1983 = 31 − 4 = 27
Number of days of August, 1983 = 31
Number of days of September, 1983 = 15 (Why?)

$$\begin{aligned}\text{Total time} &= 2 \text{ years} + (27 + 31 + 15) \text{ days}\\ &= 2 \text{ years} + 73 \text{ days}\\ &= 2 \text{ years} + \frac{73}{365} \text{ years} \qquad \text{(Why?)}\\ &= 2\frac{73}{365} \text{ years}\\ &= 2\frac{1}{5} \text{ years, i.e., } \frac{11}{5} \text{ years}\end{aligned}$$

Therefore,

$$\text{Interest} = (625 \times 12\% \times \frac{11}{5})$$

$$= \text{Rs } (625 \times \frac{12}{100} \times \frac{11}{5})$$

$$= \text{Rs } 165$$

$$\text{Hence, Amount} = \text{Rs } 625 + \text{Rs } 165$$

$$= \text{Rs } 790$$

EXERCISE 10(v)

1. Find the amount if
   (i) Principal = Rs 500, interest = Rs 15
   (ii) Principal = Rs 2372, interest = Rs 717.60
2. Find the interest if
   (i) Amount = Rs 132, principal = Rs 100
   (ii) Amount = Rs 2475.50, principal = Rs 2000
3. Find the principal if
   (i) Amount = Rs 535, interest = Rs 35
   (ii) Amount = Rs 3036.44, interest = Rs 236.44
4. Find the interest for
   (i) 2 years on Rs 1500 at 6% per annum.
   (ii) 3 years on Rs 2500 at 8% per annum.
   (iii) 9 years on Rs 3200 at 6% per annum.
   (iv) $4\frac{1}{2}$ years on Rs 750 at 4% per annum.
   (v) 3 years 146 days on Rs 500 at 12% per annum.
   [Use 1 year = 365 days.]
   (vi) 3 years on Rs 1537.50 at $12\frac{1}{2}$% per annum.
5. Charlie deposits Rs 520 in a bank. The bank pays interest at $7\frac{1}{2}$% per annum. What amount can Charlie claim at the end of one year?
6. Niraj Kumar borrows Rs 1750 for $1\frac{1}{2}$ years at 9% per annum simple interest in order to pay for a garage. What will be the amount due from him at the end of the given period of time?
7. Suresh borrowed Rs 550 from Kailash at 8% per annum simple interest. He returned the amount after 6 months. How much did he return?
8. A man deposited Rs 7200 in a finance company. If the company pays interest at 14% per year, determine the amount the man will get back after 5 years 4 months.
9. Ganeshan borrowed Rs 1500 at 6% per annum. At the end of $4\frac{1}{2}$ years, he cleared his account by paying Rs 70 and a horse. Find the cost of the horse.
10. Harish borrowed Rs 1050 from Sudhanshu on 8 October, 1962 at $7\frac{1}{2}$% per annum simple interest. How much money did he return to Sudhanshu on 3 March, 1963?

11. Neelam borrowed Rs 3650 from Ganesh on 17 February, 1979 and returned the amount on 24 September, 1981. If she paid interest at $10\frac{1}{2}$% per annum, determine the amount she returned to Ganesh.

*12. Nirmal deposited Rs 2000 in a bank on 1 January, 1980 when the rate of interest was 4% per annum. With effect from 2 March, 1980 the interest rate rose to 5% per annum. Find the interest credited to the account of Nirmal on 1 January, 1981.

[**Hint**: The year 1980 contains 366 days.]

UNIT XI

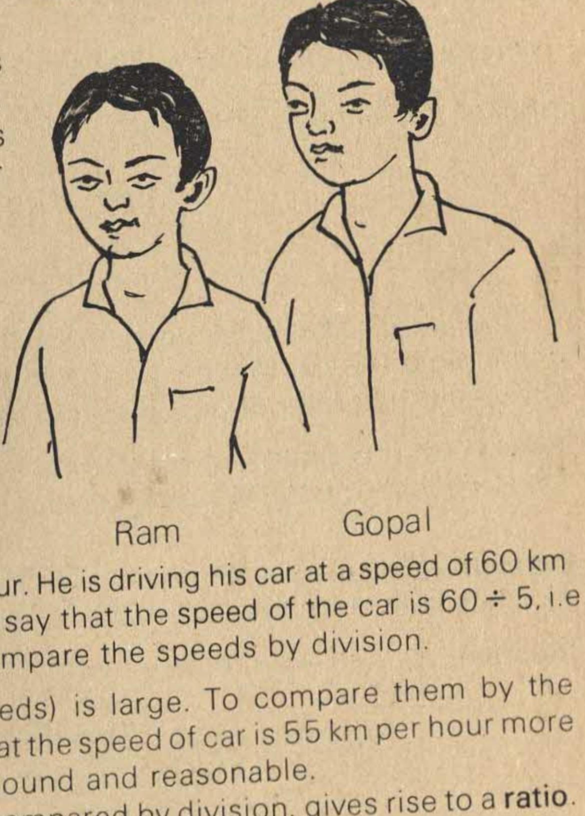
RATIO PROPORTION AND VARIATION

11.1 Ratio as a Form of Comparison

We usually compare quantities either by difference or by division. Let us consider the two situations given below:

(i) Ram is 10 years old and Gopal is 12 years old. How do we compare their ages? We often say that Gopal is 12–10, i.e., 2 years older than Ram. Thus, we compare their ages by the difference in ages.

Here the difference in quantities (ages) is small. To compare them by division, therefore, seems unsound. That is, to say that Goapl is $\frac{12}{10}$ times as old as Ram does not seem proper.



(ii) Mohan can walk at the rate of 5 km per hour. He is driving his car at a speed of 60 km per hour. To compare the speeds we often say that the speed of the car is 60 ÷ 5, i.e., 12 times the speed of Mohan. Thus, we compare the speeds by division.

Here, the difference in quantities (speeds) is large. To compare them by the difference seems unsound. That is, to say that the speed of car is 55 km per hour more than that of Mohan does not seem much sound and reasonable.

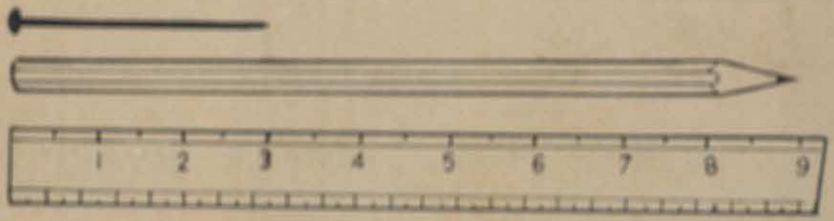
A situation, in which two quantities are compared by division, gives rise to a **ratio**.

When we divide a number by another number, we say that we are finding their ratios. In the second situation given above we say that "the ratio of the speed of Mohan to the speed of car is 5 to 60". We express this by writing symbolically as "5 : 60" or "$\frac{5}{60}$". The symbol ':', in a way, is the short form of the division symbol '÷' and, therefore, stands for division.

We read "5 : 60 as "five to sixty".

Let us now study the following examples:

Example 1: In the figure given here, find the ratio of the length of the pencil to that of the pin and the ratio of the length of the pin to that of the pencil.



Solution: We see that the length of the pencil is 9 cm and that of the pin is 3 cm. Therefore, the ratio of the length of the pencil to that of the pin is $\frac{9}{3}$ or 9 : 3 and the ratio of the length of the pin to that of the pencil is $\frac{3}{9}$ or 3 : 9.

$$\text{Also, } 9:3 = \frac{9}{3} = \frac{3}{1} = 3:1$$

$$\text{and } 3:9 = \frac{3}{9} = \frac{1}{3} = 1:3$$

Therefore, in Example 1 we can say that the ratio of the length of the pencil to that of the pin is 3 : 1 or that the ratio of the length of the pin to that of the pencil is 1 : 3. These are the same ratios **reduced to lowest terms**.

Note: A ratio is often expressed as a fraction usually reduced to lowest terms. We compute with ratios the way we compute with fractions.

Example 2: The area of a country is 2000000 square kilometres and the area of one of its cities is 500 square kilometres. Find the ratio of their areas.

Solution: The ratio of the area of the country to that of the city

$$= 2000000 : 500 = \frac{2000000}{500}$$

$$= \frac{4000}{1}$$

$$= 4000 : 1$$

The ratio of the area of the city to that of the country

$$= 500 : 2000000$$

$$= 1 : 4000 \qquad \text{(Why?)}$$

Example 3: Find the ratio of Rs 3 to 90 p.

Solution: Rs 3 = 300 p

Therefore, the ratio of Rs 3 to 90 p

$= 300 : 90$

$= \frac{300}{90}$

$= \frac{10}{3}$

$= 10 : 3$

A note to the teacher: The teacher must indicate that the ratio, when used for comparison, becomes a meaningless concept if the quantities being compared are in different units. Therefore, **to compare two quantities, i.e., to find their ratio we must express them in the same units.** This may also be indicated that a ratio has no units in itself.

Example 4: Find the ratio of

(i) 20 minutes to an hour.

(ii) 6 hours to a day.

(iii) 250 grams to 2 kilograms.

Solution: (i) Ratio of 20 minutes to an hour.
= Ratio of 20 minutes to 60 minutes (Why?)

$= \frac{20}{60}$

$= \frac{1}{3}$

$= 1 : 3$

(ii) Ratio of 6 hours to a day

= Ratio of 6 hours to 24 hours (Why?)

$= \frac{6}{24}$

$= \frac{1}{4}$

$= 1 : 4$

(iii) Ratio of 250 grams to 2 kilograms

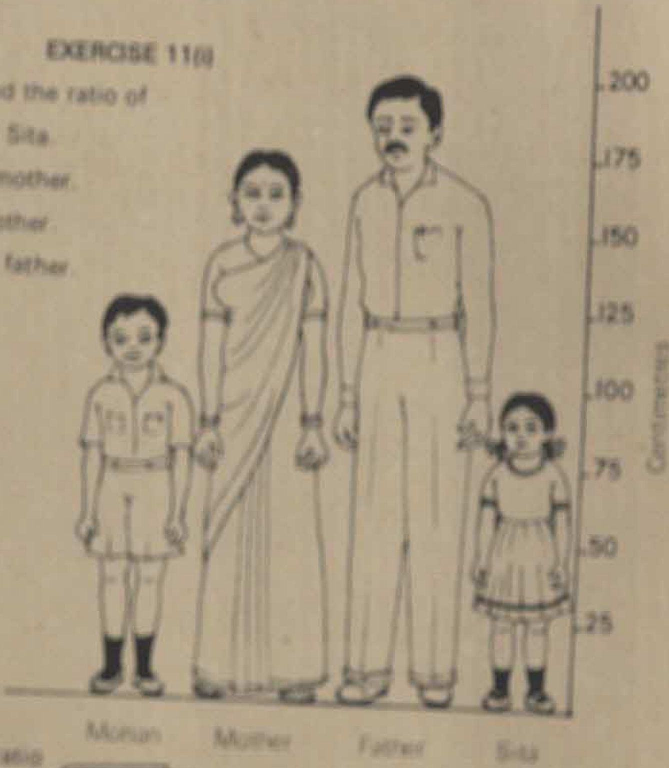
$= \text{Ratio of 250 grams to 2000 grams}$ (Why?)

$= \frac{250}{2000}$

$= \frac{1}{8}$

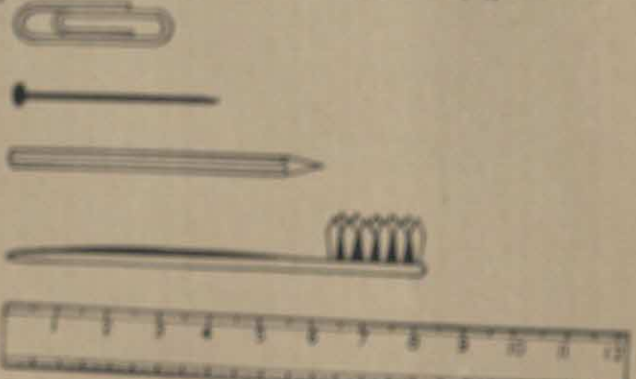
$= 1 : 8$

EXERCISE 11(i)



1. From the accompanying figure find the ratio of
   (i) the height of Mohan to that of Sita.
   (ii) the height of father to that of mother.
   (iii) the height of Sita to that of mother.
   (iv) the height of Mohan to that of father.

2. From the figure given here, find the ratio of the length of
   (i) the paper clip to that of the pencil.
   (ii) the pencil to that of the tooth brush.
   (iii) the nail to that of the pencil.
   (iv) the nail to that of the tooth brush.



3. In each of the following, express the ratio of the first number to the second in lowest terms:

   (i) 5, 35
   (ii) 21, 84
   (iii) 18, 96
   (iv) 20, 105
   (v) 130, 13
   (vi) 120, 8
   (vii) 23, 207
   (viii) 85, 365
   (ix) 1012, 960
   (x) 475, 4750
   (xi) 6238, 70006
   (xii) 7683, 7683

4. In each of the following, express the ratio of the first quantity to the second in lowest terms:

   (i) 25 p, Rs 7
   (ii) 10 hours, 1 day
   (iii) 7 months, 1 year
   (iv) 150 g, 1 kg
   (v) 775 cm, 2m
   (vi) Rs 2.75, 45 p
   (vii) 150 minutes, 4 hours
   (viii) 75 seconds, 1 hour
   (ix) 3.5 l, 350 ml
   (x) 3 years, 73 days
   (Use 1 year = 365 days.)
   (xi) 7 kg 50 g, 3 kg 525 g
   (xii) 1 kl, 1 ml

5. In a city there are 1457600 males and 1422400 females. Determine the ratio of

   (i) males to females.
   (ii) females to males.
   (iii) males to the population of the city.
   (iv) the population of the city to the females of the city.

6. Malti's monthly salary is Rs 1432.50, while her monthly expenditure is Rs 1200. Find the ratio of

   (i) her salary to her expenditure.
   (ii) her savings to her salary.
   (iii) her savings to her expenditure.

11.2 Proportion

We know that $\frac{1}{2}$ and $\frac{2}{4}$ are equivalent fractions, i.e., $\frac{1}{2} = \frac{2}{4}$

Hence, $1 : 2 = 2 : 4$

Similarly, $3 : 5 = 9 : 15$ (Why?)

$4 : 9 = 8 : 18$ (Why?)

Each of the above statements expresses the equality of two ratios.

A true statement of the equality of two ratios is called a proportion.

For example, "$1 : 2 = 3 : 6$" forms a proportion.

A note to the teacher: The teacher may state that we sometimes write "$1 : 2 :: 3 : 6$" for $1 : 2 = 3 : 6$ which means "$\frac{1}{2} = \frac{3}{6}$". We read this as "one is to two as three is to six".

A proportion consists of four **terms**. For example, 1, 2, 3 and 6 are respectively the first, second, third and fourth terms of the proportion "$1 : 2 = 3 : 6$". The first and the fourth terms of a proportion are called its **extremes**, the second and the third terms are called its **means**.

Let us consider some proportions and observe the product of the extremes and that of the means for each of them.

Proportion	Product of extremes	Product of means
1 : 2 = 2 : 4	1 × 4 = 4	2 × 2 = 4
1 : 2 = 3 : 6	1 × 6 = 6	2 × 3 = 6
2 : 3 = 12 : 18	2 × 18 = 36	3 × 12 = 36
4 : 9 = 16 : 36	4 × 36 = 144	9 × 16 = 144

In each case we find that the product of the extremes is the same as the product of the means. Hence, we conclude:

In a proportion,

the product of the extremes = the product of the means

This property of proportion helps us in determining whether the given four numbers or quantities in a particular order are in proportion. If this property is not satisfied, we say that the four numbers or quantities in that order are not in proportion. For example:

2, 3, 4, 5 are not in proportion since 2 × 5, i.e., 10 **is not** equal to 3 × 4, i.e., 12.

7, 8, 21, 24 are in proportion since 7 × 24, i.e.,168 **is** equal to 8 × 21, i.e., 168.

But the same four numbers in the order 7, 24, 8, 21 are not in proportion, (Why?)

Example 5: Supply the missing numbers:

(i) 3 : 4 = 9 : . . .

(ii) 5 : . . . = 25 : 40

Solution: (i) 3 : 4 = 9 : . . .

We find that the fourth term is missing. Since product of the extremes = product of the means. We get

3 × fourth term = 4 × 9

i.e., 3 times fourth term = 36

Since multiplication and division are inverse operations, we get the corresponding division fact as

fourth term = 36 ÷ 3

= 12

i.e., the missing number is 12.

(ii) 5 : ... = 25 : 40

We find that the second term is missing.
We have

$25 \times$ second term $= 5 \times 40$
i.e., 25 times second term $= 200$

This gives second term $= 200 \div 25 = 8$
i.e., the missing number is 8.

Example 6: Rearrange 3, 7, 28, 12 to make a proportion.

Solution: We know that
product of the extremes = product of the means

Also, $3 \times 28 = 84$
and $7 \times 12 = 84$

Therefore, 3, 7, 12, 28 or 7, 3, 28, 12 or 7, 28, 3, 12, etc. are in proportion.

Example 7: Write down a proportion corresponding to

$$\frac{3}{4} \times \frac{6}{7} = \frac{3}{8} \times 1\frac{5}{7}$$

Solution: We again make use of the property 'product of the extremes = product of means' so that we keep the pair $\frac{3}{4}$, $\frac{6}{7}$ either as extremes or as means. Thus, any one of the following represents the required proportion:

$$\frac{3}{4} : \frac{3}{8} = 1\frac{5}{7} : \frac{6}{7}$$
$$\frac{6}{7} : \frac{3}{8} = 1\frac{5}{7} : \frac{3}{4}$$
$$\frac{3}{4} : 1\frac{5}{7} = \frac{3}{8} : \frac{6}{7}$$
$$\frac{6}{7} : 1\frac{5}{7} = \frac{3}{8} : \frac{3}{4}$$
$$\frac{3}{8} : \frac{3}{4} = \frac{6}{7} : 1\frac{5}{7}$$
$$\frac{3}{8} : \frac{6}{7} = \frac{3}{4} : 1\frac{5}{7}$$
$$1\frac{5}{7} : \frac{3}{4} = \frac{6}{7} : \frac{3}{8}$$
$$1\frac{5}{7} : \frac{6}{7} = \frac{3}{4} : \frac{3}{8}$$

Example 8: The ratio of the number of kilometres travelled by a car to the number of litres of petrol consumed is 16 : 2. If the car travels 40 km, how much petrol will it consume?

A note to the teacher: The teacher should make it clear that here we are not comparing kilometres and litres but the number of kilometres and the number of litres.

Solution: Obviously we have to find the fourth term of the proportion whose first, second and third terms are 16, 2 and 40 respectively. (Why?)

We use the property

'product of the extremes = product of the means'

We have

16 times fourth term = 2 × 40

Therefore, fourth term = (2 × 40) ÷ 16 = 5
Hence, the car will consume 5 litres of petrol.

EXERCISE 11(ii)

1. For each of the following, determine whether the four quantities in the given order are in proportion:

(i) 2, 3, 4, 5
(ii) 3, 6, 6, 12
(iii) 4, 6, 8, 12
(iv) 4, 6, 8, 10
(v) 3, 2, 4.8, 2.3
(vi) $1, 1\frac{1}{2}, 1\frac{1}{2}, 2\frac{1}{4}$
(vii) 60 p, 75 p, Re 1, Rs 1.15
(viii) 20 cm, 1 m, 3.5 l, 17.5 l
(ix) 2 kg, 80 kg, 25 g, 625 g
(x) 650 m, 1 km, 650 m, 1 km
(xi) 200 ml, 2.5 l, Re 1, Rs 12.50
(xii) $1\frac{2}{3}, 2\frac{3}{4}, 3\frac{4}{5}, 4\frac{5}{6}$

2. In each of the following rearrange the quantities so that each forms a proportion:

(i) $4, 3, 4\frac{1}{2}, 6$
(ii) 10 p, 60 p, Rs 1.50, 25 p
(iii) 11 kg, 13 kg, 130 m, 110 m
(iv) 27.5 l, 26 p, Rs 1.30, 5.5 l
(v) 1.2, 1.6, 2.4, 1.8
(vi) 0.16, 0.32, 0.60, 0.30
(vii) $\frac{2}{3}, \frac{5}{6}, \frac{3}{8}, \frac{3}{10}$
(viii) 88 cl, 1.5 kg, 11 cl, 12 kg
(ix) $15\frac{2}{3}, 1\frac{5}{16}, 3\frac{15}{16}, 5\frac{2}{9}$
(x) 0.32 m, 0.64 m, $1\frac{1}{5}$, 0.6
(xi) $3\frac{1}{3}, 5\frac{1}{4}, 4\frac{1}{2}, 3\frac{8}{9}$
(xii) $\frac{1}{7}, 5\frac{5}{7}, 36, 0.9$

3. Supply the missing terms:

(i) 3 : ... = 12 : 4
(ii) 8 : 12 = ... : 36
(iii) 2 : 5 = 8 : ...
(iv) Rs 4 : ... = 8 cm : 12 cm
(v) ... : Rs 1.20 = 14 kg : 21 kg
(vi) ... : $13\frac{1}{2}$ = 3.6 : 4.5
(vii) Rs 1.20 : Rs 2 = 6 kg : ...
(viii) 9 cm : ... = 37.5 l : 12.5 l

(ix) 1 : 8 = 8 : ... (x) 6 : 66 = 66 : ...
(xi) 3 : 33 = 333 : ... (xii) 1 p : Re 1 = ... : 1 kg

4. The ratio of which number to 12 is 1 : 2?
5. The ratio of which number to 12 is 3 : 1?
6. Write down a proportion for each of the following:

(i) $8 \times 9 = 36 \times 2$ (ii) $14 \times 15 = 7 \times 30$
(iii) $\frac{1}{2} \times \frac{1}{8} = \frac{1}{4} \times \frac{1}{4}$ (iv) $\frac{2}{3} \times \frac{5}{8} = \frac{5}{6} \times \frac{1}{2}$
(v) $0.2 \times 0.9 = 0.3 \times 0.6$ (vi) $1.6 \times 1.2 = 6.4 \times 0.3$

7. Is it possible to complete a proportion for
(i) 3, 4, 5, 6? (ii) 2, 22, 222, 2222?

8. Find the fourth term of the proportion whose first, second and third terms are respectively

(i) 2, 3, 4 (ii) 2.4, 3.0, 4.8
(iii) $\frac{1}{2}, \frac{1}{3}, 4\frac{1}{2}$ (iv) $1\frac{1}{2}$, 4.5, 7.2

9. The ratio of the number of boys to that of girls in a class is 4 : 5. If there are 20 girls, find the number of boys in the class.

10. The ratio of the number of oranges bought to the number of rupees spent is 8 : 2. How many oranges can be bought for Rs 5.50?

11. There are 36 persons in a party. The ratio of the number of men to that of women is 5 : 4. How many are men? How many women?

12. The ratio of the number of girls to that of boys in a family is 1 : 1. If the family has 6 children, how many are boys? How many girls?

13. The ratio of the length of a field to its width is 3 : 2. Find its length if the width is 12 metres.

14. The ratio of the number of boys to that of benches in a school is 4:1. How many benches does the school have if there are 300 boys?

15. The ratio of the income and expenditure of a family is 7 : 6. Find the savings if the income is Rs 1400.

16. An alloy (a mixture of two or more metals) contains copper and zinc in the ratio 7 : 3. how much copper does the alloy contain if it contains 10.5 kg of zinc?

11.3 Direct Variation

We shall discuss the concept of direct variation by means of situations given below:

I. A school requires to purchase a number of copies of mathematics textbook whose cost price is Rs 6. We can represent this information in a tabular form as given below:

Number of copies of the textbook	Cost price (in rupees)
1	6
2	12
3	18
4	24
5	30

From the above table we note that

(i) The cost price increases in the same ratio as the number of copies purchased increases;

(ii) the cost price decreases in the same ratio as the number of copies purchased decreases;

(iii) the ratio of any entry in the first column to the corresponding entry in the second column remains the same, namely, 1 : 6.

II. Water is flowing out of a tap into a tanker at the rate of 3 litres per minute. If we want to determine the amount of water collected in the tanker at different times, we can use the following table:

Time (in minutes)	Amount of water (in litres)
2	6
1	3
6	18
4	12
3	9
5	15

From the above table we again note that

(i) the amount of water collected increases in the same ratio as the time (in minutes) increases;

(ii) the amount of water collected decreases in the same ratio as the time (in minutes) decreases;

(iii) the ratio of any entry in the first column to the corresponding entry in the second column remains the same, namely, 1 : 3.

In both the situations mentioned above, we say that one quantity **varies directly** as the other. In first, the cost price varies directly as the number of copies of the book. In second, the amount of water collected varies directly as the time.

When two quantities are so related that if one increases the other increases in the same ratio or if one decreases the other decreases in the same ratio, then the two quantities are said to vary directly or that one quantity varies directly as the other.

11.4 Inverse Variation

We shall now discuss the concept of inverse variation by means of situations given below:

I. A labourer can dig a trench in 24 days. We assume that all labourers do the same amount of work in a particular time. If we want to determine the number of labourers needed to dig the same trench in different intervals of time, we can use the following table:

Number of labourers	**Time taken to dig the trench (in days)**	
1	24	
2	12	(Why?)
3	8	
4	6	
6	4	
8	3	

From this table we note that

(i) as the number of labourers increases, the time to dig the trench decreases and as the number of labourers decreases, the time to dig the trench increases.

(ii) when the number of labourers is doubled, the time becomes half; when the number of labourers is thrice, the time becomes one third; and so on. In other words, if the number of labourers increases in the ratio 1 : 2, the time to dig the trench decreases in the ratio 2 : 1; and so on. The ratios 1 : 2 and 2 : 1 are called **inverse ratios.**

Therefore, we can say that when the number of labourers increases in a ratio, the time to dig the trench decreases in inverse ratio and vice-versa.

(iii) the product of any entry in the first column and the corresponding entry in the second column remains the same, namely, 24.

II. 36 horses can consume a certain stock of hay in one day. If we want to determine the number of horses which can be fed by the same stock of hay for different number of days, we can use the following table:

Number of horses	**Number of days for the stock of hay to last**
36	1
18	2
9	4
12	3
6	6
4	9
2	18

From this table we again note that

(i) as the number of horses decreases, the number of days for the stock of hay to last increases in the inverse ratio;

(ii) as the number of horses increases, the number of days for the stock of hay to last decreases in the inverse ratio;

(iii) the product of any entry in the first column and the corresponding entry in the second column remains the same, namely, 36.

When two quantities are so related that if one increases, the other decreases in the inverse ratio and if one decreases, the other increases in the inverse ratio, then the two quantities are said to vary inversely or that one quantity varies inversely as the other.

11.5 Unitary Method

When we want to solve problems involving situations like the ones given above in sections 11.3 and 11.4, we often use **unitary method.** In this method, we find the value of one quantity from the given ones and then find the value of the required number of quantities.

As it is clear from the above situations, in case of direct variation, the value of a quantity (i.e., a unit) is obtained by division and in case of inverse variation the value of a unit is obtained by multiplication. Then, the value of the desired number of units is obtained by the process opposite to that used in finding the value of the unit. To understand the method more clearly let us consider the following examples:

Example 9: Four tickets for a movie cost Rs 19.20. Find the cost of 7 tickets.

Solution: We note that as the number of tickets increases the cost increases in the same ratio. In other words the problem relates to direct variation.

Cost of 4 tickets = Rs 19.20

Cost of 1 ticket = Rs 19.20 ÷ 4 = Rs 4.80

Cost of 7 tickets = Rs 4.80 × 7 = Rs 33.60

Example 10: Krishan buys 3 kilograms of sugar for Rs 21. Sita spends, at the same rate, Rs 35 for sugar. How much sugar does Sita buy?

Solution: The problem is again on direct variation. (Why?)

Rs 21 are required for 3 kg of sugar.

Re 1 is required for $\frac{3}{21}$ kg of sugar. (Why?)

Rs 35 are required for $(\frac{3}{21} \times 35)$ kg of sugar, i.e., for 5 kg of sugar.

Therefore, Sita buys 5 kg of sugar.

Example 11: 21 workers can build a wall in 25 days. How many days will 35 workers take to build the same wall?

Solution: The problem is obviously on inverse variation. (Why?)

21 workers build the wall in 25 days.

1 worker will build the wall in (25×21) days.

35 workers will build the wall in $(25 \times 21) \div 35$ days

i.e., 15 days.

Example 12: A certain stock of wheat lasts 120 days if each person is given 225 grams of ration per day. How long will the same stock of wheat last if each person's ration is increased to 250 grams per day?

Solution: We note that as each person consumes more ration, the stock of wheat will last for a shorter duration. Therefore, the problem is on inverse variation.

If the consumption is 225 g per person, the stock lasts for 120 days.

If the consumption is 1 g per person, the stock will last for (120×225) days.

If the consumption is 250 g per person, the stock will last for $\frac{120 \times 225}{250}$ days, i.e., 108 days.

EXERCISE 11(iii)

1. For each of the following tables, determine whether the two quantities vary directly or inversely:

(i)

I	25	1	16	7	11	17
II	100	4	64	28	44	68

(ii)

I	3	32	19	45	6	2
II	$4\frac{1}{2}$	48	28.5	$67\frac{1}{2}$	9	3

(iii)

I	4	6	8	16	3	2	24
II	12	8	6	3	16	24	2

2. Fill in the blanks:

(i) The height to which a hydrogen balloon rises in the air varies directly as time.

Time (in minutes)	2	3	...	25	...
Height (in metres)	...	36	84	...	1860

(ii) The distance travelled by a car varies directly as the quantity of petrol consumed.

Distance travelled (in kilometres)	19	...	47.5	...	931
Petrol consumed (in litres)	2	3	...	50	...

(iii) To complete a work, the number of days required varies inversely as the number of persons employed.

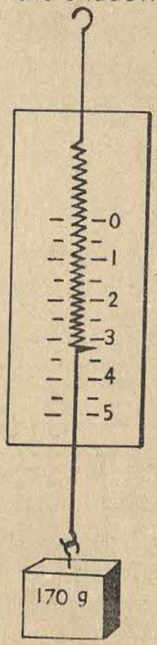
Number of days required	8	...	18	24	...
Number of persons to be employed	...	36	4	...	12

3. The price of 3 metres of cloth is Rs 79.50. Prepare a table from which the price of 4 metres, 7 metres, 15 metres and 20 metres of cloth can be read. Assume that the price varies directly as the length of the cloth.

4. A machine manufactures 24 parts in 6 hours. How many parts will it manufacture in 24 hours?

5. Find the height of a tree whose shadow is 15 metres long when the shadow of a metre rod is 75 cm.

6. The amount of extension in a spring balance varies directly as the weight on the hook. If a weight of 170 g produces an extension of 3.2 cm, what extension will be produced by a weight of 153 g?



7. If a family of 4 consumes 52 kg of cereals in a month, find the quantity of cereals required for a family of 5.

8. Fifteen envelopes cost Rs 7.50. How many envelopes can be bought for Rs 70?

9. The circumference of a circle varies directly as the diameter. If the circumference of a circle of diameter 56 cm is 176 cm, find the circumference of a circle whose diameter is 84 cm.

10. The cost of 5 aerograms is Rs 13.50. Find the cost of 17 aerograms.

11. A dealer pays Rs 960.50 for 17 chairs. Find the number of chairs the dealer can buy for Rs 5650.

12. The cost of 10 kg of sugar is Rs 72. Find the cost of 14 kg of sugar.

13. A tourist taxi is travelling from Hyderabad to Bombay (a distance of 800 km) with an average speed of 150 km in 3 hours. Find the ratio of the distance covered (in km) to the time (in hours). How long will it take to cover a distance of 360 km? What distance will the taxi cover in 2 hours 30 minutes?

14. 25 persons can cut the grass of a field in 6 days. Determine the number of days required for 15 persons to cut the grass of the same field.

15. 56 workers can reap a field in 8 days. How many more workers should be engaged to get the field reaped in 7 days?

16. 14 pumps of equal power can fill a tank in 6 days. How many more pumps of the same power are required to fill the tank in 4 days?

17. A stock of sugar lasts for $4\frac{1}{2}$ months if each member is given 900 grams of sugar per month. For how many months will the stock last if the sugar quota of each individual is reduced by 50 grams?

    [Assume that there is no increase in population.]

UNIT XII

BAR GRAPHS

12.1 Introduction

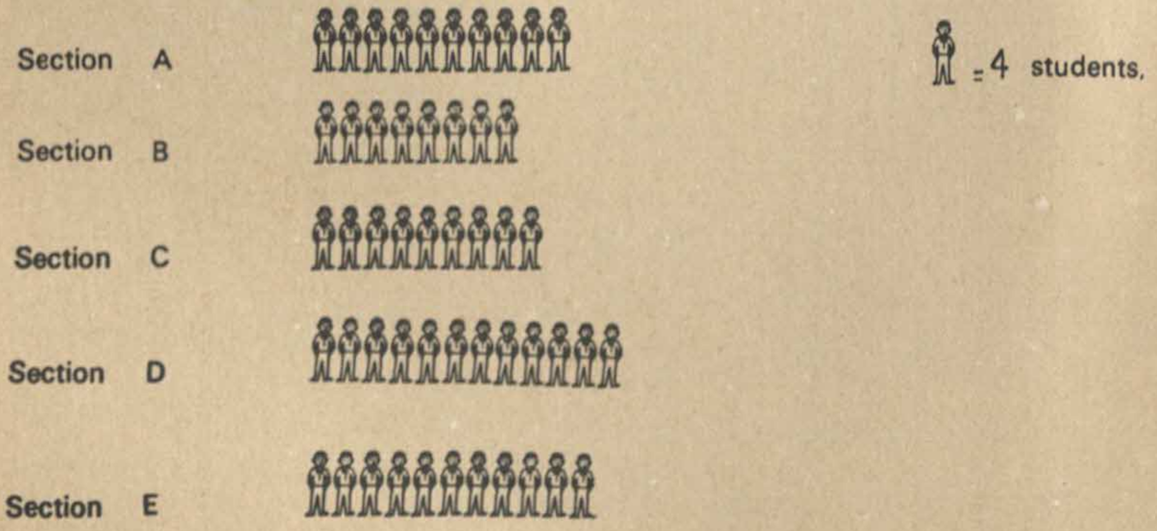
In Class IV, we learnt how to read pictographs of certain informations like rainfalls, populations, agricultural and industrial products, etc. Let us consider the following example:

Example 1: On a sunny day in the month of August, the following was the attendance in various sections of Class V of a certain school of Delhi:

Class V	Sections				
	A	B	C	D	E
Number of students present	40	32	36	48	44

The following pictograph represents the above information:

Attendance of Class V Students

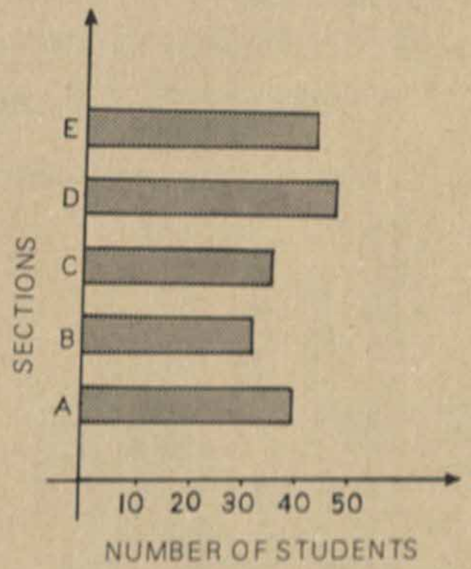


Obviously information through pictographs is time consuming and it is difficult for a common man to draw picture symbols to construct a pictograph.

Because of these shortcomings we draw **bars** instead of picture symbols to represent a given information. A bar is a shaded or a coloured rectangle drawn for the purpose of representing some information on a given scale. Graphs in which bars are used to represent various informations are called **bar graphs.**

Bar graphs are usually seen in news papers, magazines, etc. Bar graphs represent numerical facts in such a way that we can grasp them quickly, easily and clearly. We can follow and memorize at least the essential characteristics of a given information by a simple cursory glance over the bar graph.

The information of Example 1 has been represented by a bar graph in the following figure:



Attendance of Class V Students

Scale:– 1 cm represents 10 students

Here, the length of each bar represents the number of students present in the corresponding section of the class. We obviously see that bar graphs are easier to draw when compared to pictographs. In this unit, we shall learn to read and draw bar graphs.

12.2 To Draw Bar Graphs

To draw a bar graph, we first draw two lines that are perpendicular to each other. Starting from their point of intersection, along one we mark one type of information and along the other the corresponding information of the other type. For instance, in Example 1 we have marked sections along one line and the number of students along the other. Next we draw horizontal or vertical bars of equal width. These bars are drawn in proportion to the number of items to be represented. Finally, we shade or colour the bars.

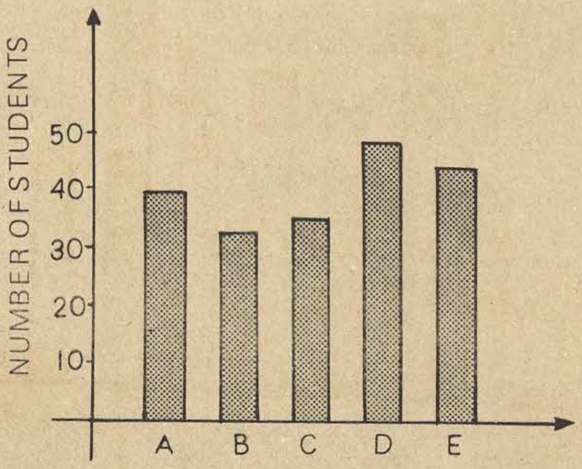
While drawing bar graphs, we keep in mind the following points:

1. **Title of the graph must be clearly written on the top of the graph.**
2. **A scale which is convenient to represent the whole of information must be clearly marked.** For example, in Example 1, we have taken 1 cm to represent 10 children and drawn the graph accordingly.
3. **The ends of the bars must be kept in horizontal or vertical line through the numerical figure it represents.** Obviously, if the bars are drawn horizontal, their ends will be vertical and if the bars are drawn vertical, their ends will be horizontal.
4. **The widths of all the bars must be the same.**
5. **Bars should be drawn at equal distances and should be shaded or coloured so that the bar graph looks attractive.**

Let us now draw a vertical bar grap (containing vertical bars) for Example 1.

Attendance of Class V Students

Scale:– 1 cm represents 10 students.



SECTIONS

> **A note to the teacher:** The teacher may point out that generally vertical bar graphs are preferred to draw.

Example 2: During a particular week, between 8 a.m. and 9 a.m., the number of cars passing through a certain road-crossing was as follows:

Sunday : 75
Monday : 130
Tuesday : 100
Wednesday : 115
Thursday : 125
Friday : 140
Saturday : 85

Draw a bar graph to represent this information.

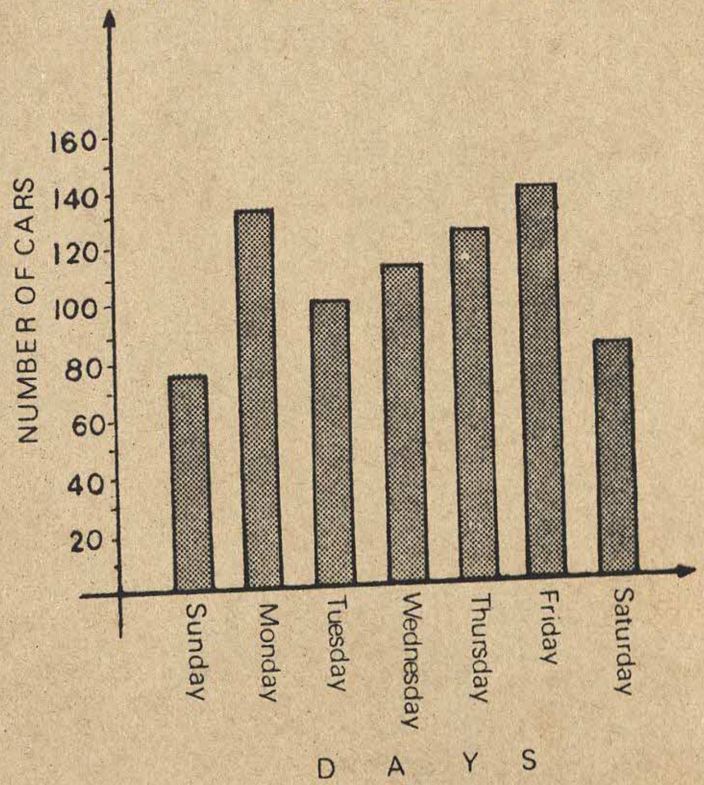
Solution: We draw two lines perpendicular to each other. Along horizontal line we mark the names of days at equal distances and along the vertical line we mark the number of cars passing through the road-crossing.

While marking number of cars, we take into consideration that $\frac{1}{2}$ cm represents 10 cars.

We then draw the graph as follows:

Number of Cars Passing through the Road-crossing During the Week

Scale:— 1 cm represents 10 cars.



Examples 3: The approximate production of food grain in India for the years 1967-72 was as given below:

Year	**Approximate production (in million tons)**
1967-68	95
1968-69	95
1969-70	100
1970-71	110
1971-72	105

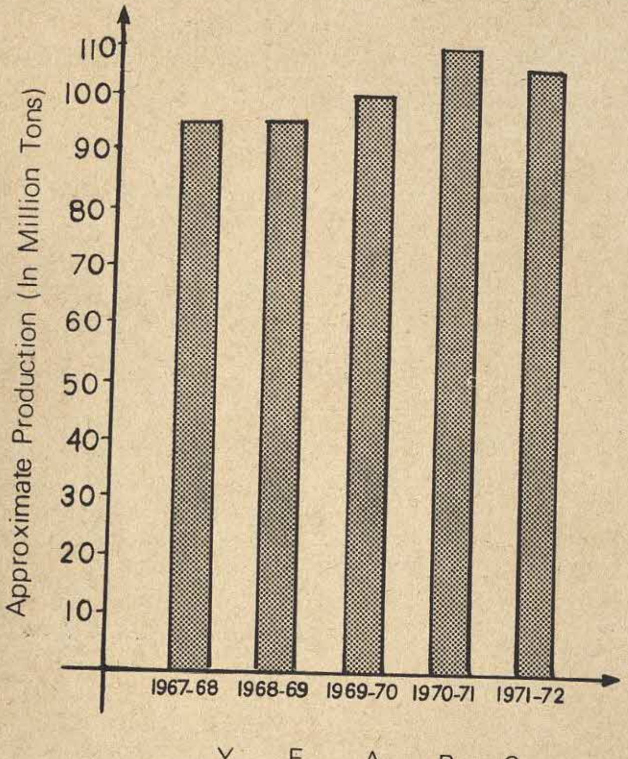
Draw a bar graph to represent this information.

[1 million = 1000000]

Solution: We use the scale 1 cm representing 10 million tons and draw the required bar graph as follows:

Approximate Production (in Million Tons) of Food Grains in India

Scale:— 1 cm represents 10 millions.

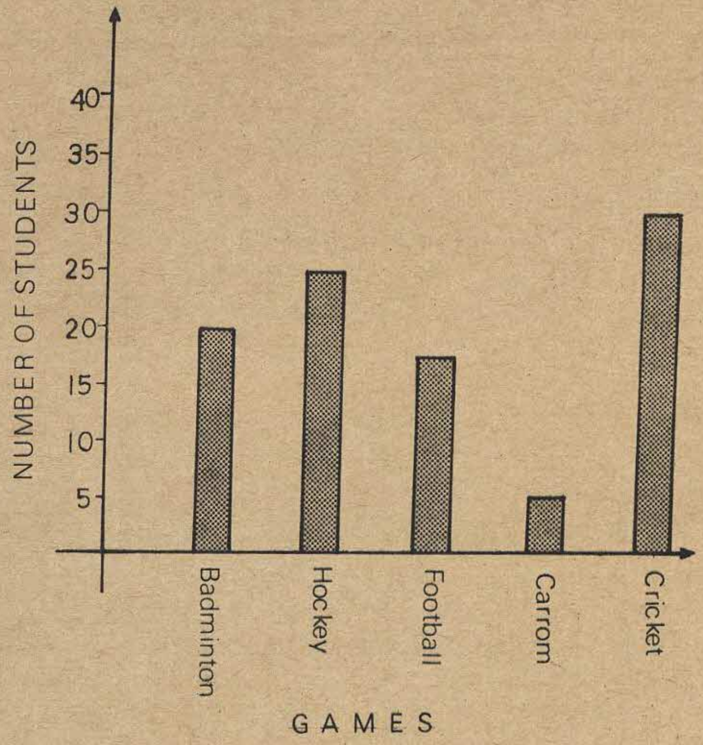


Y E A R S

Example 4: The following bar graph shows different number of students of Class V of a certain school playing various games:

Number of Students of Class V Playing Various Games

Scale:— 1 cm represents 10 students.



Read the bar graph and answer the following:

(i) What different games are played by the students of Class V?

(ii) Which game is liked most?

(iii) Which game is liked least?

(iv) How many students of Class V play
Foot ball? Hockey? Badminton?

Solution: (i) The following games are played by the students of Class V

Badminton, Hockey, Football, Carrom, Cricket

(ii) Cricket

(iii) Carrom

(iv) 15, 25, 20

EXERCISE 12

1. The number of teachers in various subjects in a particular school is given below:

Subject	**Number of teachers**
Language	7
Craft	1
Mathematics	5
Science	3
Social studies	2

Draw a bar graph to represent the above information.

2. The following table gives the approximate crop area of some States of India in the year 1971:

State	**Approximate Crop area (in million hectares)**
Andhra Pradesh	12
Assam	3
Haryana	4
Madhya Pradesh	20
Uttar Pradesh	22

Draw a bar graph to represent the above information.

[1 hectare = 1 square hectometre]

3. The income (in Indian rupees) per head of some countries during the year 1954-55 was as follows:

Pakistan	220
India	270
Indonesia	320
Burma	310
Srilanka	450
Malaya	810

Draw a bar graph to represent the above information.

[**Hint**: Use scale 1 cm representing Rs 100.]

4. The following table gives the approximate population per square kilometre of some countries in the year 1969:

Country	**Approximate population per square kilometre**
Belgium	320
U.K.	230
Japan	280
West Germany	240

Draw a bar graph to represent this information.

5. The approximate number of post offices in India in the various years was as follows:

Year	Approximate number of post offices
1951	5500
1961	7500
1971	10,000
1975	11,500
1976	12,000

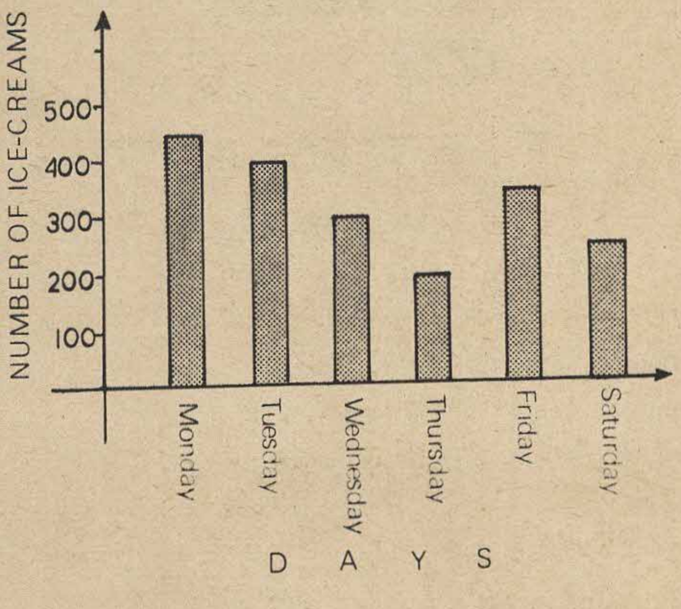
Represent the above information by a bar graph.

[**Hint**: Use scale 1 cm representing 1000 post offices. There is no need of considering a scale for years as we have to draw bars at equal distances.]

6. Read the following bar graph and answer the following questions:

Weekly Sale of Ice-creams of a School Canteen

Scale:– 1 cm represents 100 Ice-Creams.



(i) On which day maximum number of ice-creams were sold?

(ii) On which day minimum number of ice-creams were sold?

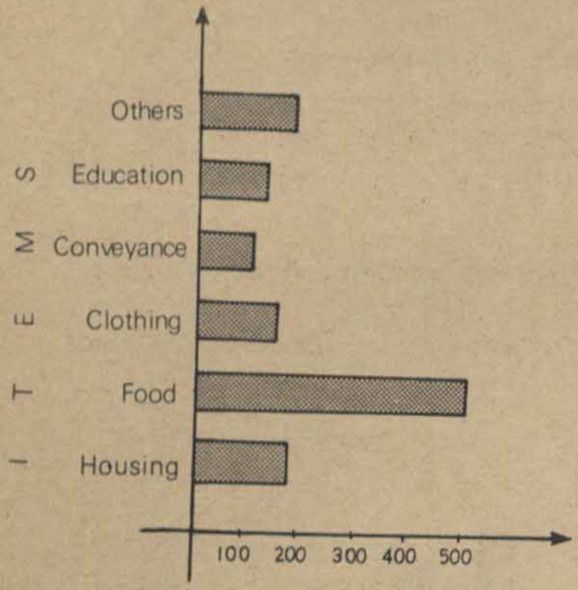
(iii) How many ice-creams were sold on Wednesday?

(iv) How many ice-creams, in all, were sold during the whole week?

7. The following bar graph shows the monthly expenses incurred by the family of Ramesh on various items:

Monthly Expenses (in rupees) of the Family of Ramesh on Various Items

Scale:– 1 cm represents Rs 100.



EXPENSES (in rupees)

(i) On which item largest amount of money is spent?

(ii) On which item least amount of money is spent?

(iii) How much money is spent on housing per month?

(iv) How much money is spent on clothing per month?

(v) Find the total monthly expenses of the family of Ramesh.

ANSWERS

EXERCISE 1

1. (i) 11023 (ii) 70007 (iii) 90909
2. (i) Thirty thousand fifteen (ii) Ten thousand one hundred twenty three
   (iii) Seventy-seven thousand seventy seven

3. (i) 62523, 62528, 62533, 62538, 62543, 62548
   (ii) 19998, 20003, 20008, 20013, 20018, 20023, 20028

4. Sixty-nine thousand fifty eight (i) 98650 (ii) 50689
5. (i) 9009 (ii) 40044 (iii) 5807 (iv) 78008
6. (i) > (ii) > (iii) = (iv) <
7. (i) 68102, 68106, 68110, 68114
   (ii) 12389, 12399, 12409, 12419
   (iii) 89953, 90053, 90153, 90253
   (iv) 88945, 89145, 89345, 89545

8. (i) 20099, 48999, 49925, 50531, 52130
   (ii) 60006, 60066, 60606, 66006, 66606

9. (i) 87000, 78908, 78809, 78199, 77777
   (ii) 5888, 5880, 5800, 5088, 5008

10. (i) 90001 (ii) 50900
11. (i) 58062 (ii) 97999
12. 11210 litres **13.** (i) 142025 (ii) 75648 (iii) 0
    (iv) 13620 (v) 34416 (vi) 134000 (vii) 71880
    (viii) 49708 (ix) 113 (x) 28 (xi) 3097 (xii) 12

14. (i) 1, 3, 9 (ii) 1, 2, 4, 8, 16, 32, 64 (iii) 1, 5, 25
    (iv) 1, 2, 4, 5, 10, 20, 25, 50, 100 **15.** Yes **16.** By testing the divisibility of the number by 2 and 9

17. Yes **18.** (i) 7 (ii) 12 **19.** (i) 180 (ii) 150
20. 12 **21.** 366
22. (i) $\frac{1}{4}, \frac{5}{18}, \frac{7}{24}, \frac{2}{3}, \frac{3}{2}$
    (ii) $\frac{4}{35}, \frac{3}{20}, \frac{2}{7}, \frac{15}{14}, 1\frac{3}{4}$
23. (i) $\frac{13}{15}, \frac{21}{30}, \frac{5}{8}, \frac{9}{16}$
    (ii) $3\frac{7}{10}, \frac{18}{5}, \frac{100}{30}, \frac{33}{10}, \frac{2}{15}$
24. (i) $\frac{41}{45}$ (ii) 5 **25.** $2\frac{1}{3}$ **26.** 4.2 litres

27. (i) 11.62 (ii) 4.445 (iii) 54.53

28. 963.8 **29.** 25 days **31.** (i) Acute (ii) Obtuse (iii) Obtuse (iv) Right

36. (i) Scalene (ii) Isosceles (iii) Equilateral (iv) Acute (v) Right (vi) Obtuse

37. (i), (iv), (vi), (vii) and (ix)

38. (i) 105 kg 525 g (ii) 1582 kg 875 g

39. 203.82 sq. m, 57.40 m **40.** Rs 311.25

41. 6 hours **42.** (i) Section E (ii) Section C
(iii) 79 students **43.** (i) 9; 9, 11; 9, 11, 13, 7, 7
(ii) 10; 10, 12; 10, 12, 14, 7, 8

EXERCISE 2(i)

1. (i) 72058564 (ii) 90710203 (iii) 30007007
(iv) 10098076 (v) 2929029 (vi) 50000005

2. (i) One crore forty-three lakh forty-five thousand eight hundred seventy six (ii) Nine crore ninety lakh five thousand sixty seven (iii) Six crore sixty-six lakh sixty-six thousand six hundred sixty six (iv) Four crore three thousand two hundred one (v) Five crore sixty thousand sixty (vi) Seven crore seventy **3.** (i) 9999997, 9999999, 10000001, 10000003 (ii) 4009998, 4010000, 4010002 **4.** (i) 6009909, 6010009, 6010109, 6010209 (ii) 99985, 100085, 100185, 100285, 100385, 100485 **5.** (i) 7439215, 7440215, 7441215, 7442215, 7443215 (ii) 16999075, 17000075, 17001075, 17002075

6. 10000004, 10000001, 9999998, 9999995

7. 901999 **8.** 9999000 **9.** 4999500 **10.** 90000

11. (i) 300000 + 40000 + 8000 + 600 + 70 + 5

(ii) 7000000 + 5000 + 1

12. 99999999 **13.** 1000000

14. Forty crore thirty-seven lakh eighty-nine thousand five hundred sixty one
(i) 987654310 (ii) 103456789

15. 9999987 **16.** 1000002

EXERCISE 2(ii)

1. (i) < (ii) > (iii) = (iv) < (v) > (vi) =
2. (i) 235694 < 356942 < 423569 < 569423 < 694235
(ii) 84036 < 888888 < 900000 < 1000000 < 30006812
(iii) 10000111 < 10010011 < 10101010 < 11001100 < 11010010

3. (i) 8963570 > 8936750 > 8935706 > 8935076 > 8930576
(ii) 52186307 > 36604518 > 10004008 > 9876000 > 9863827
(iii) 2222020 > 2220202 > 2220022 > 2202022 > 2200222

4. (i) 70000001 (ii) 9000000 **5.** 49999999

6. (i) 9000000 (ii) 90000000

EXERCISE 2(iii)

1. (i) 12408958 (ii) 69543233 (iii) 135353534 (iv) 18043499
(v) 1111095

2. (i) $\begin{array}{r} 391468 \\ +\ 99777 \\ \hline 491245 \\ \hline \end{array}$ (ii) $\begin{array}{r} 67574737 \\ +\ 2717079 \\ \hline 70291816 \\ \hline \end{array}$

3. (i) 788688 (ii) 8138781 (iii) 61124066 (iv) 0 (v) 40000001
(vi) 9222223 **4.** 39425000 **5.** 26880

6. 13552843 **7.** 1535352

8. (i) 69482500 (ii) 894576000 (iii) 42186300
(iv) 694320800 (v) 20465800 (vi) 69412800

9. (i) 9218750 (ii) 242352916 (iii) 15406872 (iv) 170463000
(v) 12630000 (vi) 25250625

10. (i) 225122625 (ii) 9278088768

11. (i) 41203498 (ii) 2639000 (iii) 0 (iv) 5064966
(v) 413600 (vi) 665600

12. (i) 63841, remainder 507 (ii) 4175, remainder 0
(iii) 6184, remainder 30 (iv) 5120, remainder 78
(v) 512, remainder 78 (vi) 100, remainder 4

13. (i) 21462, remainder 306 (ii) 2612, remainder 1121
(iii) 8268, remainder 328 (iv) 9009, remainder 7
(v) 101, remaider 3530 (vi) 1, remainder 0

14. (i) 0 (ii) 94125807 (iii) 7300654 (iv) 1 (v) 973281
(vi) 84236150000 (vii) 3003 (viii) 64
(ix) 88690 (x) 87507 (xi) 0 (xii) 0

15. 230698631 **16.** 68885 votes **17.** 279688 candidates
18. 1033950 screws **19.** Rs 9781875 **20.** Rs 91551450

21. 144000 km **22.** 4536000 litres **23.** Rs768000

EXERCISE 2(iv)

1. (i) 11 (ii) 17 (iii) 63 (iv) 1156 (v) 251 (vi) 2330 (vii) 91
(viii) 409 (ix) 10020 (x) 9879 (xi) 7444 (xii) 1002948

2. (i) VIII (ii) XIX (iii) XXXVI (iv) XLV (v) LXIX (vi) CXXVII
(vii) CDXLV (viii) $\overline{\text{VI}}$ (ix) $\overline{\text{VII}}$DCVIII (x) $\overline{\text{VII}}$ (xi) $\overline{\text{LXVIII}}$CCX (xii) $\overline{\text{C}}$

3. (i), (iii), (iv), (viii) and (x)

EXERCISE 2(v)

1. (i) 3 (ii) 6 (iii) 7 (iv) 5 (v) 13 (vi) 25 (vii) 8 (viii) 31
(ix) 21 (x) 19 (xi) 23 (xii) 30

2. (i) 100 (ii) 1100 (iii) 10111 (iv) 1110 (v) 1000100 (vi) 10011

(vii) 100001 (viii) 101000 (ix) 11101 (x) 110100 (xi) 1000110
(xii) 1010101

3. 100, 4 **4.** 1111, 15

EXERCISE 3(i)

1. (i) Yes (ii) No (iii) No (iv) Yes (v) No (vi) Yes (vii) Yes
(viii) No (ix) Yes (x) Yes (xi) No (xii) Yes

2. Yes, yes **3.** By testing the divisibility of the number by both 5 and 9 **4.** No **5.** Yes, yes
6. Yes

7. Yes **8.** No **9.** 156000 and 156500 **10.** (ii), (iv), (v), (vi)

EXERCISE 3(ii)

1. 6 **2.** 9 **3.** 9 **4.** 12 **5.** 25 **6.** 28 **7.** 19 **8.** 23 **9.** 3 **10.** 9
11. 18 **12.** 5 **13.** 8 **14.** 36 **15.** 13 **16.** 35 **17.** 36 **18.** 55
19. 58 **20.** 747

EXERCISE 3(iii)

1. (i) 60 (ii) 48 (iii) 60 (iv) 1680 (v) 1470 (vi) 1620 (vii) 4620
(viii) 6480 (ix) 6384 (x) 9240 (xi) 120 (xii) 144

3. (i) $\frac{4}{5}$ (ii) $\frac{5}{21}$ (iii) $\frac{5}{13}$ (iv) $\frac{3}{10}$

4. (i) $\frac{1}{18}, \frac{4}{18}, \frac{12}{18}, \frac{3}{18}$ (ii) $\frac{6}{30}, \frac{4}{30}, \frac{5}{30}, \frac{9}{30}$
(iii) $\frac{6}{130}, \frac{35}{130}, \frac{117}{130}, \frac{104}{130}$ (iv) $\frac{90}{180}, \frac{32}{180}, \frac{35}{180}, \frac{140}{180}$

5. 10 **6.** 56 **7.** 1628 **8.** No

EXERCISE 3(iv)

1. 120 **2.** 960 **3.** 28 **4.** 238 **5.** 17 **6.** 99960 **7.** 75 cm **8.** 5460
9. 7 m 15 cm **10.** 4 m 50 cm **11.** 336 **12.** 40 m 32 cm **13.** 5500 m
14. 605 **15.** 3780 kg **16.** 20 days, Rs 7 **17.** 69 m 30 cm **18.** 5 kg

EXERCISE 4(i)

1. (i) $2\frac{1}{3}$ (ii) 5 (iii) 3 (iv) $7\frac{7}{8}$ (v) 10
(vi) $66\frac{1}{2}$ (vii) 36 (viii) 200 (ix) $\frac{8}{45}$ (x) $2\frac{11}{16}$
(xi) $18\frac{2}{5}$ (xii) 400

2. (i) $1\frac{1}{2}$ (ii) 0 (iii) 1 (iv) $\frac{3}{8}$ (v) 0 (vi) $\frac{11}{14}$
(vii) 4, $\frac{2}{5}$ (viii) $\frac{5}{8}, \frac{5}{8}$ (ix) 15 (x) $\frac{4}{5}$ (xi) 4 (xii) $\frac{6}{25}$

3. (i) Yes (ii) No (iii) No (iv) No (v) No (vi) Yes (vii) Yes (viii) Yes
(ix) No (x) No (xi) No (xii) Yes

4. (i) 46 (ii) 1 (iii) $6\frac{11}{15}$ (iv) $1\frac{6}{7}$ (v) 1 (vi) $4\frac{1}{3}$

(vii) $\frac{33}{64}$ (viii) $26\frac{4}{9}$ (ix) $2\frac{59}{100}$ (x) $\frac{3}{4}$ (xi) 106 (xii) 4840

5. (i) 1 (ii) 15 (iii) $1\frac{1}{3}$ (iv) $3\frac{27}{40}$ (v) $2\frac{1}{15}$ (vi) 19 (vii) 21

(viii) $7\frac{1}{2}$ (ix) 0 (x) 350 (xi) $\frac{11}{27}$ (xii) $56\frac{4}{7}$

EXERCISE 4(ii)

1. (i) 1, Yes (ii) 3, No (iii) 1, Yes (iv) $82\frac{1}{8}$, No (v) $2\frac{1}{3}$, No (vi) 1, Yes

2. (i) $1\frac{1}{2}$ (ii) $\frac{3}{7}$ (iii) $\frac{4}{5}$ (iv) $3\frac{2}{5}$ (v) $\frac{3}{8}$ (vi) 1

3. (i) $\frac{1}{6}$ (ii) 6 (iii) $1\frac{1}{2}$ (iv) $\frac{2}{3}$ (v) $\frac{1}{10}$ (vi) $\frac{10}{11}$

(vii) $3\frac{2}{3}$ (viii) $\frac{2}{15}$ (ix) $\frac{3}{28}$ (x) $\frac{4}{5}$ (xi) $12\frac{1}{2}$ (xii) $6\frac{1}{5}$

4. 1 5. Less 6. Greater

7. (i) $\frac{1}{5}$ (ii) $\frac{1}{14}$ (iii) $\frac{3}{5}$ (iv) $\frac{1}{3}$ (v) $\frac{2}{11}$ (vi) $\frac{3}{10}$

(vii) $1\frac{1}{5}$ (viii) $1\frac{1}{9}$ (ix) 1 (x) $1\frac{1}{5}$ (xi) $\frac{8}{9}$

(xii) $2\frac{1}{2}$ (xiii) 2 (xiv) $2\frac{93}{98}$ (xv) 3 (xvi) 15

(xvii) 3 (xviii) 2 (xix) $1\frac{41}{63}$ (xx) $1\frac{1}{5}$ (xxi) $\frac{1}{3}$

EXERCISE 4(iii)

1. 1 2. $\frac{1}{2}$ 3. $\frac{1}{7}$ 4. 20 5. $1\frac{1}{2}$ 6. $2\frac{1}{4}$ 7. $\frac{3}{4}$

8. $3\frac{25}{28}$ 9. 1 10. $\frac{1}{3}$ 11. 200 12. 2 13. 2

14. $\frac{1}{2}$ 15. 2 16. $\frac{1}{6}$ 17. $\frac{4}{5}$ 18. $1\frac{6}{7}$

EXERCISE 4 (iv)

1. $9\frac{3}{5}$ m **2.** 77 l **3.** Rs 48 **4.** 5100 km **5.** $5\frac{7}{9}$

6. 45 m **7.** $7\frac{3}{20}$ sq. m **8.** 63 **9.** 65 km per hour **10.** $12\frac{1}{2}$ m

11. 2212, 3318 **12.** 20000, 80000 **13.** 450 l

14. 18, $\frac{14}{27}$ m **15.** 60, 10 kg **16.** 26 minutes

EXERCISE 5(i)

1. (i) Twenty four point two seven or twenty four and twenty-seven hundredths (ii) Three hundred two and eighty-seven thousandths (iii) Two thousand seven hundred and one-hundred-nine thousandths

2. (i) 0.37 (ii) 0.037 (iii) 1040.005
3. (i) 35.8 (ii) 798.52 (iii) 63.418

4. (i) $70000 + 800 + 30 + 5 + \frac{1}{100}$

(ii) $600 + 30 + 1 + \frac{9}{10} + \frac{8}{100} + \frac{7}{1000}$

(iii) $1000 + 200 + 5 + \frac{9}{1000}$ (iv) $\frac{2}{10} + \frac{7}{100}$

(v) $\frac{8}{10} + \frac{6}{100} + \frac{3}{1000}$ (vi) $\frac{9}{100} + \frac{6}{1000}$

5. (i) 0.53, 3.05, 3.65, 4.23, 4.32, 5.03

(ii) 0.009, 0.90, 0.99, 9.009, 9.09

(iii) 0.001, 0.01, 0.10, 1.001, 1.01

6. (i) 91.544 (ii) 25.677 (iii) 83.525 (iv) 6.236 (v) 109.329
(vi) 41.193

7. (i) 1.58 (ii) 0.27 (iii) 0.09 (iv) 8.067 (v) 7.028 (vi) 399.996

8. 996.426 **9.** 0.431 **10.** 1000.12

EXERCISE 5(ii)

1. (i) $\frac{6}{10} + \frac{3}{100}$ (ii) $\frac{7}{10} + \frac{5}{100} + \frac{8}{1000}$ (iii) $1 + \frac{2}{10}$

(iv) $60 + 7 + \frac{6}{100} + \frac{8}{1000}$ (v) $700 + 90 + \frac{9}{1000}$ (vi) $1000 + \frac{1}{10}$

2. (i) $\frac{1}{4}$ (ii) $\frac{16}{25}$ (iii) $\frac{49}{200}$ (iv) $1\frac{1}{5}$ (v) $2\frac{1}{2}$

(vi) $3\frac{3}{5}$ (vii) $70\frac{4}{5}$ (viii) $77\frac{7}{10}$ (ix) $44\frac{11}{25}$

(x) $4\frac{111}{250}$ (xi) $\frac{999}{1000}$ (x) $999\frac{9}{100}$

3. (i) 0.2 (ii) 0.4 (iii) 0.375 (iv) 1.5 (v) 2.25 (vi) 5.25 (vii) 16.2
(viii) 0.08 (ix) 3.32 (x) 4.05 (xi) 6.325 (xii) 7.14 (xiii) 0.008 (xiv) 3.504
(xv) 40.975

EXERCISE 5(iii)

1. (i) 23.115 (ii) 108.696 (iii) 340.74 (iv) 631.44 (v) 124.56 (vi) 190.701
(vii) 713.26 (viii) 538.65 (ix) 2585.891 (x) 0.54 (xi) 0.72 (xii) 246.928

2. (i) 4 (ii) 0.4 (iii) 0.04 (iv) 2.9 (v) 29 (vi) 0.29 (vii) 32.3 (viii) 5606
(ix) 3280 (x) 7650 (xi) 8972400 (xii) 69080

3. 51.4 (i) 514 (ii) 5140 (iii) 51400 (iv) 5.14 (v) 5.14 (vi) 0.514

4. (i) 1.44 (ii) 6 (iii) 138.776 (iv) 180.81 (v) 5.882 (vi) 0
(vii) 1.221 (viii) 52.4 (ix) 0.343 (x) 33.75 (xi) 160.4 (xii) 32

5. (i) 10 (ii) 100 (iii) 1000 (iv) 6.432 (v) 10 (vi) 0.24 (vii) 10
(viii) 5.8 (ix) 720 (x) 0.027 (xi) 930 (xii) 4.58

EXERCISE 5(iv)

1. (i) 1.3 (ii) 1.37 (iii) 1.6 (iv) 0.51 (v) 9.05 (vi) 4.25 (vii) 0.27
(viii) 4.19 (ix) 53.7 (x) 4.96 (xi) 2.27 (xii) 5.12 (xiii) 13.1 (xiv) 9
(xv) 121 (xvi) 500 (xvii) 11320 (xviii) 6696 (xix) 122700 (xx) 13.3
(xxi) 2.56 (xxii) 0.9 (xxiii) 0.3 (xxiv) 0.4

2. (i) 13.05 (ii) 2.57 (iii) 0.06 (iv) 0.352 (v) 1.644 (vi) 200.151
(vii) 0.626 (viii) 42.178 (ix) 0.007 (x) 0.007 (xi) 0.001 (xii) 0.009

3. 15.27 (i) 1.527 (ii) 152.7 (iii) 1527

4. (i) 132.78 (ii) 423.4 (iii) 0.712 (iv) 0.081 (v) 0.03 (vi) 0.75

5. (i) 2.25 (ii) 1.11 (iii) 8 (iv) 10 (v) 87.5 (vi) 29.28

EXERCISE 5(v)

1. (i) 2300 g (ii) 4500 ml (iii) 135 cm (iv) 25.18 m (v) 2.35 kg (vi) 67.29 l

(vii) 11.5 quintals (viii) 0.75 tons

2. 13.6 cm **3.** 60.25 runs **4.** 19.8 runs **5.** 13 sq. cm **6.** 39.6 m **7.** (i) 74.58 km
(ii) 298.32 km **8.** (i) 0.865 kg (ii) 21.625 kg **9.** 0.25 l **10.** (i) 243 km
(ii) 324 km **11.** (i) 35.05 kg (ii) 280.4 kg **12.** (i) 0.285 l (ii) 0.456 l
13. (i) 216.96 kg (ii) 271.2 kg **14.** 27 l **15.** 338.25 g **16.** Rs 4.80
17. (i) Rs 18.95 (ii) Rs 11.05

EXERCISE 6

1. (i) 29 (ii) 110 (iii) 11.6 (iv) $5\frac{8}{15}$ (v) $1\frac{3}{4}$ (vi) $7\frac{33}{40}$
(vii) 0 (viii) 3.4 (ix) $4\frac{9}{40}$ (x) 4.8 (xi) $7\frac{1}{2}$ (xii) 3.9

2. (i) $5 \times (2+3)$ (ii) $12 \div (7-4)$ (iii) $2 \times (5+9) - 8$ (iv) $40 \div \{(9+6)+1\}$
(v) $2 \times \{(19-6)-1\}$ (vi) $\{(50-5)+2\} - \{(4 \times 5)-1\}$

3. (i) 40 (ii) 29 (iii) 0 (iv) $26666\frac{2}{3}$ (v) 11 (vi) 0.84 (vii) 8.4 (viii) 87
(ix) 119 (x) 71 (xi) 80 (xii) 25.5 (xiii) 24 (xiv) 68 (xv) 33
(xvi) 123.76 (xvii) 151.152 (xviii) $1\frac{1}{2}$ (xix) $11\frac{5}{12}$ (xx) $14\frac{2}{5}$

EXERCISE 7(i)

1. (i) Acute (ii) Obtuse (iii) Obtuse (iv) Right (v) Straight (vi) Acute

2. (i) Acute (ii) Obtuse (iii) Right (iv) Obtuse (v) Straight (vi) Acute

4. (i) D, E (ii) F, G (iii) A, H, B, C

9. (i) 50° (ii) 35° (iii) 28°

10. (i) 20° (ii) 150° (iii) 44° **11.** No. **12.** No.
13. (i) No (ii) No (iii) Yes
14. (i) c and f are supplementary angles (ii) a, b, and d, e, are pairs of complementary angles. (iii) c and f are vertically opposite angles.
15. 45° **16.** 90° **17.** (ii)

EXERCISE 7(ii)

4. Yes **5.** Yes **6.** Yes **7.** Infinite, one **8.** Yes **11.** Yes

EXERCISE 8(i)

1. 70° **2.** (i) 90° (ii) Right (iii) 90° **3.** No **4.** No **5.** (i) Yes (ii) No
(iii) Yes (iv) No (v) No (vi) No **6.** 100°, 80° **7.** Yes **10.** 30°

EXERCISE 8(ii)

1. (i) A, B, U, C, D (ii) P, R (iii) Q, T, S **2.** 100° **3.** (i) No (ii) No (iii) Yes
4. Yes **5.** No

7. All angles are right and the diagonals are equal.

8. All sides are equal and the diagonals are the right bisectors of each other.

10. Yes, yes **11.** (i) 180° (ii) 180° (iii) 180° (iv) 180°

13. (i), (iv) and (v)

EXERCISE 8(iii)

2. (i) D, N (ii) B, M, O, P (iii) A, C, Q, R **3.** Yes, yes **5.** Yes **6.** No **7.** Interior
8. Yes **9.** Yes **10.** Yes

11. Circumference is slightly more than three times the diameter.

12. No **13.** Yes, in two points **14.** Yes, in one point

EXERCISE 9(i)

1. 20 cm **2.** 22 cm **3.** Rs 740 **5.** 1.4 sq. m **6.** $6\frac{1}{4}$ sq. cm **7.** Square, 4 sq. cm **8.** 10000 **9.** 2 metre square = 4 sq. m **10.** 18.1025 sq. m **11.** (i) Yes (ii) Rectangular field, 200 m **12.** 1000 tiles **13.** 72 pieces **14.** 24 stamps **15.** 464 plants **16.** 50 plots **17.** (i) Area is doubled. (ii) Area remains the same. (iii) Area becomes four times. **18.** 24 cm

EXERCISE 9(ii)

1. (i) 84 sq. m (ii) 70 sq. m (iii) 57.6 sq. m **2.** 350 sq. m **3.** Rs 3074 **4.** 68.2088 sq. m **5.** 5.76 sq. m **6.** Rs 2479.50 **7.** 67.92 sq. m **8.** 65.2 sq. m **9.** 24.4 sq. m **10.** 243.2 sq. m **11.** Rs 154.40 **12.** 3.5 m **13.** 8.82 sq. m, 2.1 sq. m **14.** 138 m, 1184 sq. m, 434 sq. m **15.** 26 sq. m

EXERCISE 9 (iii)

1. (i) 8 cu. units (ii) 3 cu. units (iii) 12 cu. units (iv) 15 cu. units (v) 4 cu. units (vi) 20 cu. units
2. (i) 750 cu. cm (ii) 461.25 cu. cm (iii) 86.4 cu. m (iv) 58.125 cu. m **3.** 240 cu. cm **4.** 6751
5. 9000 1 **6.** (i) 17.5 cu. cm (ii) 1063.125 cu. m **10.** 56250 cu. cm **11.** 640 **12.** 1.287 m
13. 4.5 kg **14.** 300 **15.** 1500 kl

EXERCISE 10 (i)

1. (i) 5% (ii) 60% (iii) 25% (iv) 45% (v) 30% (vi) 16% (vii) $87\frac{1}{2}\%$
(viii) $31\frac{1}{4}\%$ (ix) $187\frac{1}{2}\%$ (x) 245% (xi) $433\frac{1}{3}\%$ (xii) $3333\frac{1}{3}\%$

2. (i) $\frac{3}{20}$ (ii) $\frac{9}{25}$ (iii) $\frac{21}{100}$ (iv) $\frac{11}{20}$ (v) $\frac{3}{4}$ (vi) $\frac{4}{5}$
(vii) $1\frac{1}{10}$ (viii) $2\frac{1}{4}$ (ix) $3\frac{1}{2}$ (x) $1\frac{11}{25}$ (xi) $6\frac{1}{2}$ (xii) 1

3. (i) 25.6% (ii) 171.2% (iii) 3652% (iv) 1640% (v) 980% (vi) 2%
(vii) 0.6% (viii) 120.5% (ix) 608.3% (x) 1% (xi) 111% (xii) 90%

4. (i) 0.253 (ii) 1.286 (iii) 9.985 (iv) 0.125 (v) 0.38 (vi) 0.76 (vii) 0.9
(viii) 0.019 (ix) 0.025 (x) 0.001 (xi) 0.006 (xii) 0.09

EXERCISE 10(ii)

1. (i) 7% (ii) 28% (iii) 188% **2.** (i) 18% (ii) 60% (iii) 120%
3. (i) 2% (ii) 12% (iii) 87.5% **4.** (i) 5% (ii) 12.5% (iii) 90.5%
5. (i) 10% (ii) 750% (iii) 0.5% **6.** 10% **7.** (i) 25p (ii) Rs 3 (iii) Rs 15 (iv) Re 1 (v) 200 g (vi) 1.5 kg (vii) 6.5 kg (viii) 3.5 kg (ix) 630 ml (x) 12.5 l (xi) 80 kg (xii) 80 kg **8.** (i) 500 kg (ii) Rs 800 (iii) 400 l (iv) 4 tons (v) 400 m (vi) 150 ml (vii) 243 g (viii) 4.5 quintals (ix) 10 m (x) 40 cm **9.** (i) 50% (ii) $33\frac{1}{3}\%$ (iii) 40% (iv) $44\frac{4}{9}\%$ (v) $16\frac{2}{3}\%$ (vi) $10\frac{10}{19}\%$ **10.** 93.75 % **11.** 20 % **12.** $12\frac{1}{2}\%$

EXERCISE 10(iii)

1. 75 **2.** Hindi **3.** 90 **4.** 28 **5.** Better **6.** 75% **7.** $79\frac{1}{6}\%$ **8.** 25%. **9.** Food: 31.25%. Housing: 12.5%. Clothing: 9.375%, Others: 46.875% **10.** 76%, 24% **11.** (i) 25% (ii) 50% **12.** $85\frac{5}{7}\%$ **13.** Rs 2850 **14.** Rs 1000 **15.** Rs 8.75 **16.** 37.5%, 12.5% **17.** 25% **18.** $97\frac{1}{2}\%$

EXERCISE 10(iv)

1. (i) Profit: Rs 4 (ii) Profit: Rs 20 (iii) Loss: Rs 6.50 (iv) Loss: Rs 19.50
(v) Profit: Rs 3.75 (vi) Loss: Rs 5.50

2. (i) Rs 78.15 (ii) Rs 183.95 (iii) Rs 766.85 (iv) Rs 24.60 (v) Rs 1219
(vi) Rs 8761.10

3. (i) Rs 499 (ii) Rs 300 (iii) Rs 3040.60 (iv) Rs 45151.60

4. (i) Profit: 5% (ii) Profit: 20% (iii) Profit 20% (iv) Loss: 20%

5.

S.P	C.P	Proft	Loss	Profit %	Loss %
Rs 25	Rs 20	Rs 5	—	25	—
Rs 72	Rs 75	—	Rs 3	—	4
Rs 98	Rs 84	Rs 14	—	$16\frac{2}{3}$	—
Rs 45	Rs40	Rs 5	—	$12\frac{1}{2}$	—
Rs 80	Rs 85	—	Rs 5	—	$5\frac{15}{17}$

6. Rs 89.05 **7.** Rs 11.60 **8.** Rs 4 per dozen **9.** 40% **10.** Rs 5 **11.** Loss: 4% **12.** Rs 624.75 **13.** 25% **14.** $8\frac{1}{3}\%$ **15.** Rs 945 **16.** Rs 352 **17.** 40 p **18.** Rs 39.90

EXERCISE 10(v)

1. (i) Rs 515 (ii) Rs 3089.60 **2.** (i) Rs 32 (ii) Rs 475.50 **3.** (i) Rs 500 (ii) Rs 2800
4. (i) Rs 180 (ii) Rs 600 (iii) Rs 1728 (iv) Rs 135 (v) Rs 204 (vi) Rs 576.56
5. Rs 559 **6.** Rs 1986.25 **7.** Rs 572 **8.** Rs 12576 **9.** Rs 1835
10. Rs 1081.50 **11.** Rs 4646.45 **12.** Rs 96.67

EXERCISE 11(i)

1. (i) 5 : 4 (ii) 8 : 7 (iii) 4 : 7 (iv) 5 : 8 **2.** (i) 1 : 2 (ii) 3 : 4 (iii) 2 : 3
(iv) 1 : 2 **3.** (i) 1 : 7 (ii) 1 : 4 (iii) 3 : 16 (iv) 4 : 21 (v) 10 : 1 (vi) 15 : 1
(vii) 1 : 9 (viii) 17 : 73 (ix) 253 : 240 (x) 1 : 10 (xi) 3119 : 35004 (xii) 1 : 1

4. (i) 1 : 28 (ii) 5 : 12 (iii) 7 : 12 (iv) 3 : 20 (v) 31 : 8 (vi) 55:9 (vii) 5 : 8
(viii) 1 : 48 (ix) 10 : 1 (x) 15 : 1 (xi) 2 : 1 (xii) 1000000 : 1

5. (i) 911 : 889 (ii) 889 : 911 (iii) 911 : 1800 (iv) 889 : 1800 **6.** (i) 191 : 160
(ii) 31 : 191 (iii)31 : 161

EXERCISE 11(ii)

1. (i) No (ii) Yes (iii) Yes (iv) No (v) No (vi) Yes (vii) No (viii) Yes
(ix) No (x) Yes (xi) Yes (xii) No

2. (i) 4, 3, 6, $4\frac{1}{2}$ (ii) 10 p, 25 p, 60 p, Rs 1.50 (iii) 11 kg, 13 kg, 110 m, 130 m
(iv) 26 p, Rs 1.30, 5.5 l, 27.5 l (v) 1.2, 1.6, 1.8, 2.4 (vi) 0.16, 0.32, 0.30, 0.60
(vii) $\frac{2}{3}$, $\frac{3}{10}$, $\frac{5}{6}$, $\frac{3}{8}$ (viii) 11 cl, 88 cl, 1.5 kg, 12 kg (ix) $15\frac{2}{3}$ $3\frac{15}{16}$ $5\frac{2}{9}$, $1\frac{5}{16}$
(x) 0.32 m, 0.64 m, 0.6, $1\frac{1}{5}$ (xi) $3\frac{1}{3}$ $4\frac{1}{2}$, $3\frac{8}{9}$, $5\frac{1}{4}$ (xii) $\frac{1}{7}$, $5\frac{5}{7}$, 0.9, 36

3. (i) 1 (ii) 24 (iii) 20 (iv) Rs 6 (v) 80 p (vi) 10.8 (vii) 10 kg (viii) 3 cm
(ix) 64 (x) 726 (xi) 3663 (xii) 10 g

4. 6 **5.** 36 **6.** (i) 8 : 2 = 36 : 9 (ii) 7 :14 = 15 : 30 (iii) $\frac{1}{4}:\frac{1}{2}=\frac{1}{8}:\frac{1}{4}$

(iv) $\frac{2}{3}:\frac{5}{6}=\frac{1}{2}:\frac{5}{8}$ (v) 0.2 : 0.6 = 0.3 : 0.9 (vi) 0.3 : 1.2 = 1.6 : 6.4 **7.** (i) No
(ii) No **8.** (i) 6 (ii) 6.0 (iii) 3 (iv) 21.6 **9.** 16 **10.** 22 **11.** 20 men,
16 women **12.** 3 boys, 3 girls **13.** 18 m **14.** 75 **15.** Rs 200 **16.** 24.5 kg

EXERCISE 11(iii)

1. (i) Directly (ii) Directly (iii) Inversely

2. (i) First row : 7, 155 Second row : 24, 300 (ii) First row : 28.5, 475 Second row : 5, 98
(iii) First row : 2, 6 Second row : 9, 3

3. Cost of 1 m of cloth = Rs 26.50 **4.** 96 **5.** 20 m **6.** 2.88 cm **7.** 65 kg **8.** 140
9. 264 cm **10.** Rs 45.90 **11.** 100 **12.** Rs 100.80 **13.** 50 : 1, 7 hours 12 minutes, 125 km
14. 10 days **15.** 8 workers **16.** 7 pumps **17.** $4\frac{13}{17}$ months

EXERCISE 12

6. (i) Monday (ii) Thursday (iii) 300 (iv) 1950

7. (i) Food (ii) Conveyance (iii) Rs 175 (iv) Rs 150 (v) Rs 1225

Form No. 3.

PSY, RES.L-1

Bureau of Educational & Psychological Research Library.

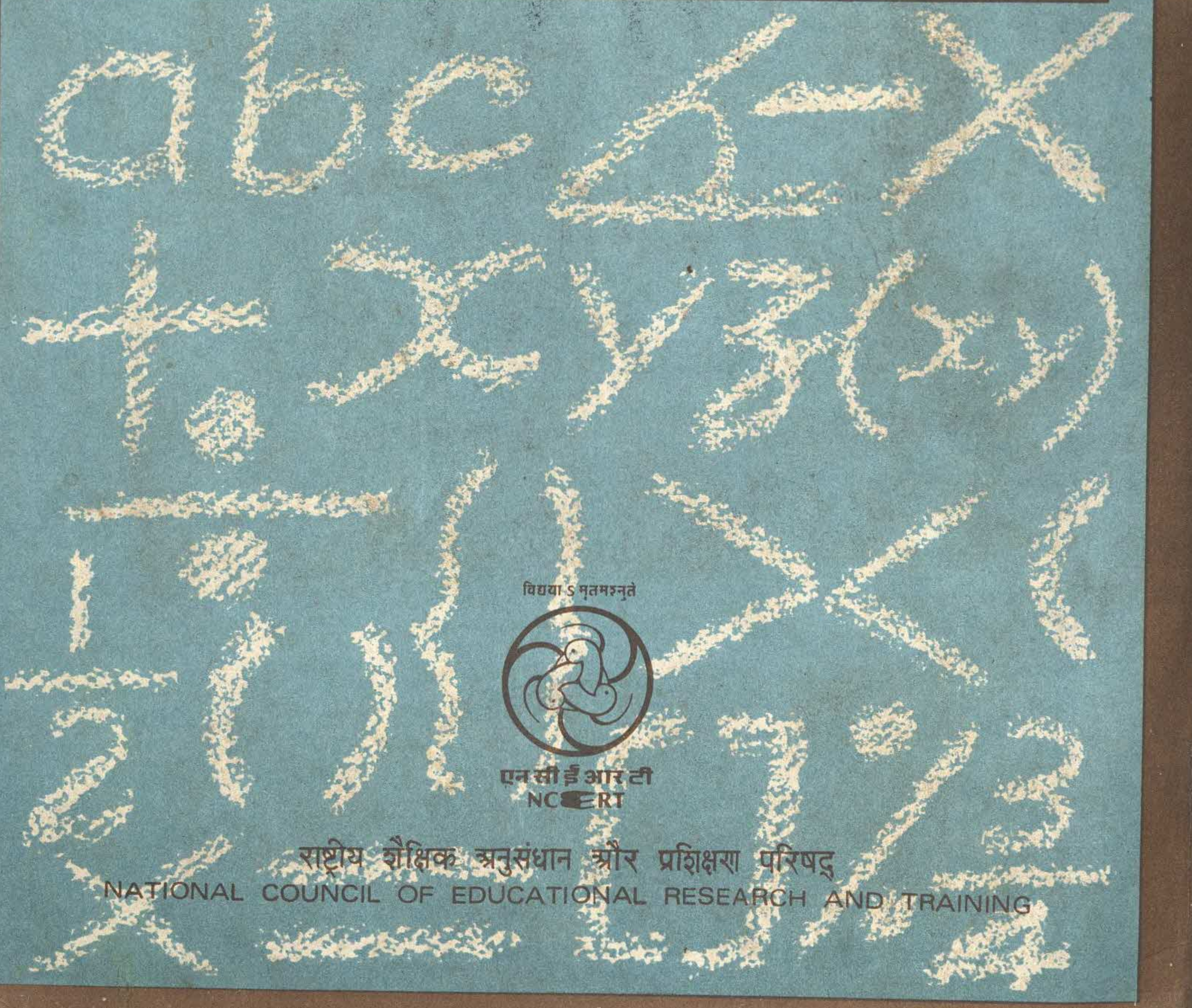
The book is to be returned within the date stamped last.

WBGP-59/60-5119C-5M

MATHEMATICS

FOR PRIMARY SCHOOLS

BOOK V



विद्यया ऽमृतमश्नुते

एन सी ई आर टी
NCERT

राष्ट्रीय शैक्षिक अनुसंधान और प्रशिक्षण परिषद्
NATIONAL COUNCIL OF EDUCATIONAL RESEARCH AND TRAINING